UNIVERSITY OF PENNSYLVANIA

A STATISTICAL STUDY OF PROFITS

RAYMOND T. BOWMAN

A THESIS

IN ECONOMICS

PRESENTED TO THE FACULTY OF THE GRADUATE SCHOOL IN
PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR
THE DEGREE OF DOCTOR OF PHILOSOPHY

PHILADELPHIA

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PREFACE

This study attempts to apply the methods of frequency distribution analysis to distributions of earnings ratios. The earnings ratios are in all instances percentages of "net earnings" to "investment." The analysis was undertaken with the idea that such an investigation would have significance from at least two standpoints. First, it would provide information on earnings in such a way as to give a clear insight into the meaning of average earning rates for an industry and the variation in earnings ratios among the different concerns within that industry. Second, it would present the material in such a manner as to provide tentative premises of an empirical order for the construction and modification of profit theory.

The text material is so organized that the general scope of the study, the principal ideas as to methodology, and the final conclusions may be available to those readers who do not care to follow the details of the technique. The readers who wish to avail themselves of this short cut should read all of Chapter I, pages 34 to 37 and 57 to 85 of Chapter II, and all of Chapter VI. If, having completed the reading in this form, the reader desires more details regarding the individual parts of the conclusion they may be obtained by consulting the various summary sections in Chapters III and IV. These summaries are clearly marked in the Table of Contents. Chapter VI, which presents the general summary and conclusions, indicates by numerous footnotes the sections in the more technical parts of the study from which the conclusions are derived, so that the reader who cares to pursue any particular point further may readily do so.

The ideas here presented, and the methods employed, were developed from suggestions made by Professor Simon S. Kuznets, and first took the form of a doctoral dissertation. The development of the study in its present form was made

possible through a grant in aid by the Faculty Research Committee of the University of Pennsylvania. Without this grant, it would not have been possible to carry out the numerous calculations which were involved. For assistance in the preparation of the final manuscript, I owe a debt of gratitude to Professor Paul F. Gemmill, who has read it many times and offered innumerable suggestions. It is hardly necessary to say that the faults which still remain are faults of execution for which I alone am responsible.

For helpful comments on the study I am indebted to Mr. Aaron Goldstein, of Cambridge, Massachusetts; to Mr. Solomon Fabricant, of the National Bureau of Economic Research; to Professors J. Parker Bursk, Paul F. Gemmill, F. Cyril James, C. K. Knight, Simon S. Kuznets, S. Howard Patterson, and Karl W. Scholz, of the University of Pennsylvania; and to Dr. Dwight B. Yntema, of Chicago.

For clerical assistance in carrying out the numerous tedious calculations, I am greatly indebted to Messrs. Emerson W. Graver, Henri Sokolove, Sidney C. Sufrin, Miss Louise Albert, Miss Margaret Hastings, Mrs. Edith M. Otto, and Miss Isabel Shetler. They have given intelligent coöperation that has made the pursuit of the study a pleasure and has convinced me that co-laborers who are not directly responsible for the type of work turned out may yet be as careful of results as the person upon whom this responsibility rests. Mrs. Otto typed the final manuscript with a patience that was remarkable in view of the numerous changes that made much painstaking work go for naught. My wife, Edna Cowgill Bowman, also assisted in the statistical work and made up and typed Appendix B. For any errors that have gone undetected, I accept, of course, full responsibility.

RAYMOND T. BOWMAN

Philadelphia, January 1, 1934

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A STATISTICAL STUDY OF PROFITS

CHAPTER I

THEORETICAL AND STATISTICAL RATIONALE

"Probably in no part of the entire field of economic theory is there more need for inductive evidence which will enable a set of sound generalizations to be built up than in that of business profits."[1] With this sentence, Professor Ralph C. Epstein introduces a recent article. Writing still more recently, he adds: "In spite of the many inductive materials by which economic science has been enriched during the years that have elapsed since the Great War, insufficient data have been developed as yet in connection with the question of profits."[2] If we admit that these statements are true, as we well may, we raise the question of what conditions account for this lack of empirical information about business profits. The explanation is to be found not only in the character of the economic concept of profits itself, but also in the lack of the proper original data. A brief investigation of these two factors will supply ample evidence to support this contention.

Theoretical Aspects

The Concept of Profits

When we analyze the concept of profits that the economist has in mind, we discover that it differs considerably from the accountant's understanding of that same term. This difference may be explained in terms of the different objectives which are being pursued by the accountant and the economist. The accountant is interested in determining the amount by which the actual earnings exceed the expenses during the period of the accounting. The financial structure of the busi-

[1] "Statistical Light on Profits as Analyzed in Recent Literature," *Quarterly Journal of Economics*, February, 1930, p. 320.

[2] "Profits and Size of Firm in the Automobile Industry, 1919–27," *American Economic Review*, December, 1931, p. 636.

ness, the compensation paid to executives in the form of salaries, the interest on the funded debt, and other items of expense are for him given factors which need no further analysis. Profit, to him, is the difference between the income realized and the payments made or contracted for during the period, with some allowance for depreciation and obsolescence. The proprietor or proprietors of the business, if it is an individual proprietorship or partnership, have equities in the business which allow them to claim such net earnings, and the accountant is interested in telling them the size of these earnings. If the business is a corporate organization, the stockholders have equities which allow them to claim certain parts of such earnings, with the general decision whether all earnings shall be paid out as dividends or part paid as dividends and part reinvested in the business left to a board of directors elected by those stockholders who have this privilege as part of their general rights in the business.

The economist, on the other hand, is interested in a much broader problem than the accountant. The economist is attempting to separate the various factors which will explain or account for the entire distribution of the gross income of society. The mere fact that an individual receives a payment which is called salary, wages, or interest does not suffice to answer all of the questions he has in mind. The profit concept of the economist may be viewed in various ways, but it is the opinion of the present writer that one general concept is basic. The term profits is often used to describe the income of a certain class of individuals. For instance, all individuals who receive income the amount of which was not definitely contracted for in advance may be said to receive profits. Historically, the largest class of individuals of this sort were the individual proprietors, or entrepreneurs as they were called, who conducted business enterprises for gain. These individuals were, in general, the owners of the business. They contracted to pay certain prices for the items necessary for the conduct of the business, and if the prices received for the products produced were more than suffi-

cient to cover the expenses of production the enterpriser was said to make a profit; if the reverse was true, he was said to suffer a loss.

Later analysis has attempted to divide this residual share into parts and to show that unless this share was larger than the amount which could have been earned by the enterprisers as salaried employees of others, and as investors receiving interest, they did not really earn profits but merely wages of management and interest.

In a perfectly competitive economy the share going to the enterpriser over and above wages of management and interest would be reduced to zero, and the term profits would not be necessary to describe the share of any individual. We can see clearly now that the basis of the profit concept is not the character of the individuals receiving it, but the character of the income received. Furthermore, we see that the expenses contracted for are supposed to be contracted for in a competitive market, and if, due to circumstances that are not truly competitive, wage or interest charges are made which leave no residual share for the enterpriser, we cannot say that the business was not profitable. Certain forces have conspired to allow the laborers or the capitalists, rather than the enterpriser, to reap the profits.

When the most common form of business organization is the corporation, the enterprisers are said to be the stockholders, since they alone do not have a contract for a definite payment, but must depend for their income upon the success or failure of the business. Directors, presidents, and other managing officers may receive salaries which are so high as to allow the general body of stockholders an amount of return on their equities which is in reality merely interest on their investment. The accountant would report this return as profits, but the economist's purpose is not served by such an analysis.

The breakdown of the income of the enterpriser into several shares really requires us to stop thinking of profits in terms of a certain class of individuals as recipients, and to

substitute the concept of profits as the payment for a certain *function* in production—the most common function now mentioned being uncertainty bearing. The analysis of this concept is even more easily seen to be reducible to the concept of profits as a share that would not be present if competition were perfect. Since the purpose of the present study is to analyze the earnings ratios of business enterprises and discover whether they help to clarify profit theory, it is essential that we state clearly the discrepancies that exist between the earnings ratios utilized and the type of earnings ratio that would correctly depict the profits of the economist. In order to do so it will be necessary to outline briefly the general equilibrium analysis of economic theory, and in doing this to express our explanation in terms of ideal earnings ratios so that we may be able later to appraise correctly the relationship of the actual ratios to the ideal ones.

A word of caution is necessary at this point. Our entire purpose in this chapter is to present a clear analysis of the *concept* of profits as developed in the general body of economic doctrine. We are not attempting to review or appraise the various profit theories. We refer to profit theory in this chapter merely to show that the concept of profit necessarily requires that a theory of profits employing this concept shall be outside the general analysis of static equilibriums in terms of which the shares of wages, interest, and rent are expressed. Such statements form the basis for a theory of profits, but do not constitute an explanation of the amounts of profits which occur from industry to industry, from place to place, or from time to time, and such an explanation is an essential part of a theory of profits.

If we assume that all payments which are made by different enterprises are on a perfectly competitive basis and represent the "normal" payments of competitive theory, and if by total investment we mean the original value, on a perfectly competitive cost basis, of the various properties that are used in the conduct of the business, then if net earnings, after the deduction of (1) the competitive interest charge on

investments not calling for interest payment, and (2) the wages of management, are expressed as a percentage of total investment, we have a correct expression of a *profit ratio* as generally understood in economic theory. In some instances, where one industry involves more risk than another, a compensation for this risk is considered to be a necessary competitive charge in the long run, but more will be said about this later. If the net earnings before any allowance is made for interest payments or taxes on income are computed as a percentage of the total investment as defined above, we have as a result what will hereafter be called the ideal earnings ratio.[3]

It will be possible to show later that earnings ratios of this type will allow us to analyze the profit elements in such earnings if the ratios are treated in certain ways. Since this type of ratio can be more nearly approximated in empirical investigations, it will be to our immediate advantage to analyze the elements of such an ideal ratio when viewed in terms of the concept of profits.

Constituent Parts of Net Earnings

The first and most obvious part of the net earnings, as just defined, is commonly thought of as necessary interest on the total investment. Moreover, if the enterprise is an individual proprietorship or partnership and the enterprisers have not included in the expenses of the business their own salaries, figured on their probable earning power as employees of others, then part of the net income is really compensation for labor. Where corporations are concerned, wages of management are generally included in the wage payments, but in this case certain problems arise as to the interpretation to be given the actual salaries charged as expenses and the amounts that should be charged on a competitive basis. We have escaped this problem in our ideal ratio since we have assumed that all payments are normal competitive pay-

[3] With regard to the measurement of earning power, see J. H. Bliss, *Financial and Operating Ratios in Management*, pp. 78, 79. For our objections to the method of computing investment suggested by Bliss, see pp. 80, 81.

ments. In addition to these two elements, a third division is often made. The risks which surround particular industries may show wide variations. When such risks can be taken care of by insurance, or by other devices calling for some specific payment, their costs will be included among the expenses of individual concerns in the particular industry, and will introduce no new elements into the analysis. It may be, however, that, although the risk conjunctures surrounding an industry are not predictable, they are more numerous in some industries than in others. Since such risks constitute, by hypothesis, part of the community's knowledge, they may be partially discounted in advance and thus act as a normal cost of production. This point must be developed later when we consider the distinction between predictable and non-predictable risks. Our present purpose is served by merely mentioning the possible distinctions so as to pave the way for the more detailed discussion coming later.[4]

Net earnings which are either larger or smaller than are required to cover the three payments just enumerated are said to constitute elements of pure profit. These pure profits can be either positive or negative quantities. The sum of the three elements enumerated above, which are thought of as constituting necessary payments, is often called "normal profits." This designation grows out of the theoretical analysis based on the assumption of a competitive price economy and can be understood only in terms of such an analysis.

Competitive Price Theory and Pure Profits: General Approach

The division of net earnings just described can be completely understood only by considering the nature of the forces which, in a competitive economy, would bring perfect equilibrium to the price system. Nevertheless, they can be described sufficiently for our present purposes by means of a briefer analysis. The term normal profits, which includes interest, wages of management, and sometimes the payment

[4] For an illuminating treatment of this topic, consult Frank H. Knight, *Risk, Uncertainty and Profit* (particularly Chapter II).

for certain risks, refers to the theoretical net earnings that must be obtained in every industry, and by every concern in every industry, if equilibrium is to be attained. This conclusion is a necessary deduction from the hypothesis of perfect competition when we consider that under such conditions the investment in the given industry will increase or decrease as the price of the product that is being produced covers or does not cover the necessary costs. We assume that any decrease in the investment will be followed by a decrease in production, and that such a decrease in the investment will take place unless we include as necessary costs the items enumerated above as normal profits.

As a result of these conditions, the element which we have called interest must be equal in all industries. Furthermore, compensation for management must be equal to the wages that could be obtained by the managers if they entered the employ of other enterprisers. Only when this is true will the investment and management tend to remain unchanged. In like manner, an industry which by its very nature involves additional elements of risk must, because of these risks, make earnings which will bring it into equality with other industries not surrounded by such risks.

The equilibriums descriptive of perfect competition in both space and time imply the absence of unpredictable events. The attainment of the equilibriums is not prevented, even though changes take place, so long as the changes are perfectly predictable. Equilibriums thus developed do not imply that normal profits will be identical in amount for all industries, but merely that such profits will compensate for the costs enumerated by the items of normal interest, wages of management, and risks. The idea of normal profits differs slightly, depending upon whether the element of risk included as a necessary expense is thought of as being limited to predictable risks only, or including other risks as well. If the risks are perfectly predictable, then the cost of such risks can be made part of the actual expenses, and they need not enter into normal profits at all. Under these conditions the

idea of normal profits does not imply customary profits, but merely the net earnings which would be realized if competition were perfect, in relation to both space and time. In some instances, the concept of normal profits is broadened to include elements of risk which are known to distinguish one industry from another, but which are not definitely predictable. Such an element introduced into the concept of normal profits implies that the variations in net earnings among individual concerns in an industry will bring about an average net return for the industry as a whole which will, in the long run, allow all industries to make about the same percentage of net earnings on their investments. Under this interpretation, the assumption of competition is not perfectly rigorous, and the elements of uncertainty will allow differences in earnings ratios for the individual concerns in a given industry; the forces of competition, however, will prevent any marked deviations in earning power between the different industries.

With these concepts of normal profits clearly in mind, it is evident that, if "pure profits" exist, they must arise out of the imperfect nature of competition as actually realized, since the postulation of perfect competition has eliminated all earnings that are larger or smaller than normal profits. Let us suppose that we wish to discover whether the earnings of individual concerns in the actual world of affairs merely equal normal profits or contain elements of pure profits. If we obtain the amounts of net earnings and total investments in a number of industries so that we can compute, for each concern, the ratio of net earnings to total investment then, as a result of these computations, we may find there are differences in the ratios between individual concerns in the same industry; and, when the earnings ratios of concerns in a given industry are averaged, we may discover that these average ratios differ for each industry. Do such differences give a definite answer to the question of whether the different concerns earn only normal profits, or pure profits as well?

We have already stated that the theoretical rate of interest included in normal profits must be the same for every concern, and hence for every industry. This conclusion follows from our hypothesis of perfect competition, since, if normal interest is the payment necessary to maintain an investment in a given enterprise, and perfect and instantaneous mobility is present, then differences in interest-earning power cannot exist. Other circumstances surrounding a given industry or individual concern may require payments larger or smaller than those received by others, but these elements should not be confused with interest.

The wages paid for managerial capacity, when in exact correspondence with the concept of normal wages of management, are understood to be of such amounts that no incentive exists to induce managers to change to the position of hired workers. If, as is generally admitted, individuals differ in abilities, both original and acquired, then, if the capacities for managing the individual enterprises in different industries vary, the competitive wages of managers, if employed as hired workers, would differ. Within a given industry, no variation in abilities would be required, under perfect competition, since the individual business units would be of the size most advantageous for that industry, and therefore differences in normal wages of management could exist only as between industries, and not between several concerns within a given industry. Considering these two elements only, we see clearly that if concerns earned normal interest and normal wages of management only, then we should expect no differences among earnings ratios for concerns in the same industry, but we might look for some differences between industries, although we should hardly expect such differences to be large.

The third element which we have included in our concept of normal profit—risk—is somewhat more difficult to analyze. We should have included only predictable risks if we had desired to stick close to the concept of perfect competition, because non-predictable risks would, in reality, be a

denial of such an hypothesis. If predictable risks exist, it seems obvious that these risks, if they relate to the individual concerns and are predictable for them, can be entered directly as expenses. If they are predictable for an industry but not for the individual concerns, they can be, and, under perfect competition, would be, made the subject of insurance, and hence would constitute part of each concern's individual expenses. It should be clear, however, that individual concerns within a given industry cannot, *under conditions of perfect competition*, have predictable risk conjunctures which differentiate them from other concerns within the same industry. It follows, therefore, that the important element to be considered, when answering the question of whether normal profits are equal for all industries, is not the predictable risks surrounding individual concerns, but the risks which distinguish one industry from another. The best way to approach this problem is to consider it from two points of view: first, as it is effective at a point in time (or, as we sometimes say, spatially); and, second, over a period of time. It may be true that, at every instant in time, certain industries differ with regard to the predictability of the risks which surround them. For instance, the predictable amount of fire risk borne by some industries is much larger than that borne by other industries. If such items are perfectly predictable from year to year for the different industries, certainly the net earnings of the industry with the greater risk must be sufficient to meet the yearly contingencies and thus cause the normal profit of that industry to be larger than the normal profit of other industries. If the risks are such that they are not accurately predictable from year to year, but are predictable, on the average, over a period of years, then this average amount of risk must be the basis for the additional net earnings required by the industry as normal profits. *If these conditions are true, however, such risks can be included in actual expenses, and need not be considered as elements of normal profits at all.* If the risks are not perfectly predictable, a modification of the competitive hypothesis must be introduced

which allows individual concerns in a given industry to experience the fortunes that wait upon uncertainty; but the hypothesis of competition is retained to the extent that the variations in earnings rates are expected, in the long run, to bring about a virtual equality between the earning rates of *different industries* if the differences in risks be taken into account.

As the result of our analysis of the elements contained in normal profits, we have discovered that mere differences in the earnings ratios of different industries are not indicative of the existence of pure profits. On the other hand, the differences between the earnings ratios of individual concerns in the same industry do indicate the existence of pure profits. We may conclude, then, by saying that if, upon empirical investigation, we find a wide variation in the net earnings ratios of individual concerns, the variations indicate the existence of pure profits. We cannot, of course, say exactly what amount of the earnings should be called normal profits, but if we take any arbitrary amount it will not affect the distribution of the actual net earnings ratios. If the arbitrary figure for normal profits is too high, we shall be overestimating the extent to which negative pure profits prevail, but a frequency distribution of the net earnings ratios would be an empirical representation of the play of forces which bring about deviations from normal profits and create pure profits.

Competitive Price Theory and Pure Profits: Marshallian Approach

The analysis above has established the concept of normal profits for a perfectly competitive society, and has shown that if the earnings ratios of the individual concerns in a given industry differ, then the actual earnings contain elements of pure profits. If pure profits do exist, then the competitive conditions postulated are not perfectly descriptive of the actual world in which we live; the existence of pure profits is a measure of the imperfections of competition, and such profits may be accounted for in terms of these imperfections. Such

a statement, however, does not explain pure profits, since nothing has been said of the characteristics of the various elements disruptive of perfect competition or of their relative importance in the determination of the amount of pure profits. In other words, a worthwhile explanation must show the nature of the causal universe from which pure profits arise, and the present analysis of the concept of normal profits and pure profits helps us by suggesting the forces that are *not* responsible.

The procedure in the analysis of the competitive forces which throws the most light on the competitive and non-competitive as well as the predictable and non-predictable forces is best exemplified by the writings of Alfred Marshall. This method has been called the "static" method. Instead of postulating a perfectly competitive society and then proceeding to analyze the equilibriums that must be attained within such a society, we merely examine certain specified forces present at a given moment and consider the future consequences that would be realized if these forces were allowed to work themselves out without interruption. For instance, there are, among the forces present at any given moment, some forces which, *if allowed to work themselves out*, would produce their effect in the immediate future. There are others which would not make themselves felt until a more remote future. This method of analysis seems to introduce the element of time, but in reality the concept of time is not involved.[5] It is called the static method because it takes certain forces present at a given moment in time, and proceeds to derive the equilibriums which would be attained if these forces were left undisturbed. In time itself, new forces may enter and the actual historical sequence of events may differ from the portrayal of equilibriums that arise as a result of the static approach. It is this difference between the description arising out of the static method and the actual development of historical events in time, that serves to bring to view the

[5] See Redvers Opie, "Marshall's Time Analysis," *Economic Journal*, June, 1931, pp. 199–215.

elements introduced in time which destroy the perfect realization of the static description.

When this type of analysis is used, net earnings which are larger or smaller than normal profits are conceived as arising out of a large variety of elements not included in the idea of perfect competition or present conditions. One element in particular that illustrates this concept is the immobility of investments during short periods. The return resulting from such immobility Marshall calls "quasi-rent." When the element of quasi-rent is considered, one element in pure profits is distinguished. Pure profit still remains, a differential arising out of the divergence between the dynamic conditions of the actual economy and the assumed conditions of the equilibrium analysis. Quasi-rent is that part of the difference between net earnings and normal profits which results from the fact that capital assets are fixed for periods of time and cannot be shifted immediately.

This change in the approach to the theory does not modify greatly the general idea of profits, but it does aid in clarifying the character of the factors which affect the net earnings ratio. This is even more clearly evident in Marshall's normal price equilibriums. In his analysis of "market price," we find that the supply curve is not based upon past cost of production. The price realized for a product need bear no necessary relationship to its past cost of production; hence pure profits at any given moment are possible. If the pure profits thus produced are positive, the different concerns in the industry *as already organized* will, according to Marshall's analysis, increase their outputs until the marginal cost of each concern is equal to the price. Under the opposite condition, they will decrease their output until the same relationship holds between cost and price. A new type of supply curve is thus generated, based upon the marginal cost of production of different quantities of output. This equilibrium price, described by Marshall as the "short-run normal price," allows some concerns, all concerns, or no concern to make either positive or negative pure profits, or some to

make positive, others zero, and still others negative pure profits. Finally, Marshall takes into account the long-run forces, and assumes that the industry as a whole would so adjust itself to the conditions of demand that the long-run normal price would be in equilibrium with a cost of production which is representative of the industry as a whole. This cost of production he calls the "cost of production of the representative firm." It is important to note that this equality between price and the cost of production of a representative firm, does not eliminate pure profits for individual concerns within that industry, nor does it *necessarily* eliminate pure profits for the industry as a whole. The latter part of this statement becomes understandable if we realize that a skew distribution of costs would cause the modal, the median, and the mean cost of the industry to deviate from each other. Since there is no assurance that Marshall's costs of the representative firm are identical with the mean costs of the industry, it is evident that more than fifty per cent of the concerns may make either positive pure profits or negative pure profits. It is true, of course, that if Marshall considered all of the forces present at any given moment, and allowed no unpredictable changes to interfere with their workings, then the costs of different producers would become equal, and pure profits for the industry and for the individual concerns within the industry would of necessity disappear.

Factors Influencing Net Earnings

This analysis of the concept of profits does not in itself offer any hypothesis to explain the relative importance of the factors which govern the actual earnings which individual concerns may be making from year to year. The character of the explanation of normal price relationships out of which the concept of profits arises does, however, offer some suggestions as to the elements of dynamic life which must be considered if an explanation of profits as thus defined is to be developed; and, furthermore, it throws some light on the broader question of net earnings as actually recorded in books of account.

Accepting for the moment the general long-run significance of the theoretical concept of profits, we know the following conditions to be true: if complete equilibrium in a perfectly competitive society (including perfect mobility for the factors of production) is assumed, pure profits are equal to zero. Such a conclusion follows of logical necessity, once the premises on which the theory is constructed are accepted. These premises involve the *complete* working out of a *given* set of forces in a competitive society. The competitive society need not be considered as static, since we can include predictable changes. If the changes can be measured accurately in advance, the factors of production are assumed to be so allocated to their different uses that, when equilibrium is attained, every producer of a given commodity will have the same costs as every other producer of that commodity, and will sell his product at the same price. Such an equilibrium adjustment means that the price of the product will be based upon the quantity of the good produced, which in turn will depend upon the quantity of the factors of production allocated to that industry by the pricing process. Equilibriums of this type can be attained only if the prices of the goods produced are equal to the costs of production. Shifts in demand may take place, population may increase, and technical improvements may develop (so long as they are equally predictable and known to all members of the competitive society) without invalidating the conditions of the theory.

These conditions, as we know, are never realized completely, since the forces present at any moment are never allowed to work themselves out without being hindered by some conditions which are not predictable in advance. If, as is generally assumed, these equilibrium forces are the major forces, then actual conditions will approximate, but never completely represent, equilibrium conditions. If, however, the new and unpredictable conditions are the more important, and continue to remain the more important, the equilibrium analysis, when presented at a given moment, may be true enough for the conditions postulated, but the his-

torical occurrence of events in time will not be represented, even approximately, by such a picture.

Quantitative Differences among Net Earnings Ratios: Theoretical Aspects

We are now in a position to outline some of the elements which the analysis of the *concept of profits* in economic theory might suggest as accounting for differences in net earnings ratios, and hence in pure profits. This can be done by enumerating the various elements which are known to be present in this uncertain world of ours. The following outline[6] is based upon a threefold classification (numbered I, II, and III):

I. Factors accounting for differences in net earnings ratios among the individual concerns in the same industry. This division can be sub-divided into two parts (lettered A and B):

   A. We might assume that the same product is manufactured by all concerns in the industry and sold for the same unit price. Under this general assumption, differences in net earnings ratios might arise as a result of the following conditions:

      1. All individual concerns within the industry, having started at different times, have assets which, if compared from the standpoint of equivalence of output would have different costs, either as a result of changes in the price level or improvements in the construction of capital goods, if such improvements are not being offset by a proportionate increase in the cost of capital. (This condition gives rise to one type of quasi-rent, and represents an effect which arises out of the immobility of fixed capital for short periods. Such a condition illustrates the presence of uncertainty.)
      2. The same assets, even though they have equal costs, might, when organized or operated by one

[6] The items enumerated in this outline owe a great deal to the suggestions offered by R. A. Lehfeldt in an article entitled "Analysis of Profits," *Journal of Political Economy*, June, 1925, pp. 278–92.

enterpriser, have greater productive effectiveness than when operated by another enterpriser. (This type of influence gives rise to what might be called a rent of business ability. The idea of a differential rent of business ability need not be the same thing as normal wages of management. The normal wages of management are based on the idea of a competitive price for the labor of the managers. As managers, they may exhibit abilities that they could not exhibit as hired labor, and reap a reward in the form of pure profits.)

3. (a) Concerns located in different geographic divisions may secure the same agents of production at different prices, due to the immobility of labor and the lack of perfect knowledge of the differences in prices; or (b) more adroit bargaining by some enterprisers may make it possible for them to secure the necessary current means of production at prices which are below the "normal" prices described by the general economic equilibrium; or (c) differences in the size of the individual concerns may bring about internal economies which make it possible for concerns of some given size to operate at lower average unit costs than other concerns.

B. We might assume that these products, though called by the same name because of their technical construction, may be sold at different prices. Such a condition might arise from one or more of the following possibilities:

1. Special trade-marks, copyrights, or customs may play a large part in the marketing of the product. (Such differences in net earnings are monopolistic in character, and are a rent paid because of *artificial* scarcity.)
2. Some concerns may be recipients of lucky orders during the year or may sell at advantageous times during the year.

II. Factors accounting for differences in net earnings ratios among industries:

A. An increase or decrease in the demand for the products of some one industry might take place so rapidly and in such an unpredictable manner as to make it impossible for capital and labor to enter that industry fast enough to equalize the earnings of that industry with those of other alternative fields. (This is a second type of quasi-rent arising out of the immobility of capital among industries.)

B. The character of a certain industry might be such that the elements of uncertainty surrounding it are very numerous, but the *possibility* of individual enterprisers making large positive earnings is so great that the capital ventured in the industry remains large and the rate for the industry as a whole remains small.

C. Certain industries may be largely under monopolistic control, so that the free movement of capital and output is not possible.

III. Factors accounting for increases in earnings ratios in many industries at the same time:

A. Earnings in many industries might rise or fall for certain periods of time (e.g., in certain phases of the business cycle). This might be due to changes in the price level of such a nature that finished products increase in price out of proportion to the changes in the prices paid for fixes assets, labor, and raw material.

By pursuing various methods of study and analysis, it may be possible to determine with some exactness the weight of various elements, such as these just suggested, in the determination of pure profits. But the enumeration of the various conditions from which pure profits may arise should not be considered as the formulation of a theory of profits. This chapter in no way attempts such a task, but is concerned with presenting the concept of profits. It is true, however, that most of the theories of profits place their emphasis upon one or more of these factors; but the limitations of this study do not permit a review and appraisal of these

theories.[7] It is evident, of course, that no accountant computes profits which correspond to the pure profits of the economist. Furthermore, we all know that the accounting procedures of the different concerns and industries do not always present data that are strictly comparable, and earnings ratios derived from their balance sheets and income statements would not meet the conditions of our ideal earnings ratio. None of these difficulties or obvious objections have been mentioned in the analysis thus far. If comparable data on net earnings to total investment can be secured, then certain experimental attempts to gain an insight into the determination of profits may be feasible. But the material to be analyzed shortly has many imperfections, and the conclusions that are reached must be viewed in the light of these imperfections; the method, however, may have greater merit than the conclusions if, with better data, the findings could be more exactly interpreted. Any statistical investigation which attempts either to test theories of profits advanced by economists, or to modify these theories, is employing the statistical investigation as a complement to theory, and must take into consideration the limiting conditions expressed or implied in the hypotheses under consideration. When due weight is given to these expressed or implied conditions, the statistical investigation may find itself severely restricted, since the material available for analysis is not always in the form which the theory requires. If, on the other hand, the statistical analysis of the data is not limited by these theoretical considerations, but the induction is developed on the basis of the type of material analyzed, then the results obtained cannot be directly contrasted with the theoretical construction resulting from a given set of conditions, but must rest their claim to excellence upon the practical uses to which they can be put. The problem facing

[7] For reviews and criticisms of the various profit theories consult Frank H. Knight, *op. cit.*, Chapter II; Theo Suranyi-Unger, *Economics in the Twentieth Century*, Part 2, Chapter V, sec. 13; Part 3, Chapter V, sec. 13–14; Part 4, Chapter V, sec. 18–21; and Harold E. Batson, *A Select Bibliography of Modern Economic Theory 1870–1929*, Bibliographies on Risk and Profits.

us might be worded as follows: using the statistical tools at our disposal, how can we define the type of statistical approach that is required if an empirical foundation for the construction of profit theory is to be attained?

Statistical Rationale

Introduction: Interpretation of Theoretical Aspects

Our analysis shows that it is practically impossible to secure from the records of business concerns any exact measures which correspond to the economist's concept of either normal or pure profits. The type of data available from accounting records relates to the difference between total receipts and *actual* expenditures. Accounting processes allow us to secure a measure of net earnings, but in many instances such earnings are not exactly like our ideal. If the ratio of the net earnings to the total investment employed in the business could be shown to deviate only slightly from the ideal ratio, it might be used as a measure of the relative earning power of different investments for different concerns in the same industry and in different industries. Since most corporations include wages of management in the expenses, and since a distinction between predictable risks and non-predictable risks (in the sense in which these terms are used in the theory just analyzed) is hard to make, we are justified in assuming, until the contrary is demonstrated, that the net earnings contain merely normal interest and pure profits. Normal interest is identical for all concerns, and hence the differences in the net earnings ratios represent, in large part, differences in pure profits. If the accounting procedure has understated or overstated wages of management, or if the total investment to which the net earnings are expressed as a ratio has been incorrectly stated, then adjustments must be made in our interpretation of such net earnings ratios, as will appear presently. If this procedure is viewed in the light of the equilibrium approach, some of the factors ruled out of the equilibrium analysis may serve to explain the differences in net earnings ratios. The question to be considered

at this point is the statistical procedure best fitted to aid us in such an analysis of net earnings ratios.

Quantitative Differences among Earnings Ratios: Statistical Aspects

Statistically speaking, net earnings ratios may be computed either for individual concerns or for groups of concerns which are said to make up an industry. The problem of determining exactly what is meant by the term "industry" is much more difficult than, at first glance, it appears to be. If every individual concern produced only one product, and several concerns produced exactly the same product, then this group of concerns producing the same product might be called an industry. The affairs of actual life are not quite so simple as this. A concern often produces more than one product, and two concerns seldom actually produce identical ones. Consequently, the best that we can do is to group together the concerns whose products are similar; and when a concern offers several products, we must allocate it to an industry on the basis of its most important output. The reason for this procedure is quite evident. We are assuming that concerns producing like products as the largest proportion of their individual outputs are more likely to be surrounded by identical conditions than are concerns producing very unlike products. Whether any classification of industries actually constructed is a good one or not, will depend upon whether the assumption is really true. For instance, suppose we should group into one industry all concerns engaged in manufacturing food products. It may be that manufacturers of cereal foods differ more widely from producers of dressed meats than either of these two differ from producers of leather. Even classifications which are more restricted may suffer from the same difficulty. Suppose we should include all concerns manufacturing shoes as members of a given industry. As a result we may find that the conditions surrounding the manufacture and sale of women's shoes are markedly different from those affecting men's shoes.

When we attempt to eliminate all discrepancies we get back to the individual concern and generalizations become exceedingly difficult.

In part, at least, such questions must await the accumulation of empirical data. We may find in our investigation regarding net earnings ratios that much can be gained by classifying concerns into industries, or we may find that the attributes of such industries, as regards net earnings ratios, are similar for all classifications, and hence that little is to be gained by grouping them into industries. On the other hand, we may find that the question cannot be definitely answered as yet, since the actual groups for which we have data are not true industries and must be broken down into more homogeneous groups.

Assuming for the moment that earnings ratios for individual concerns or industries can be the subject of comparison, we shall find it convenient in later discussions to indicate broad divisions as a basis for organizing the comparisons. Broadly speaking, the analysis may involve the comparison of earnings ratios without reference to time as a variable. A period of time may be gathered together, and the earnings ratios at different times during the period may be compared without reference to their time sequence, or spatially, as it were. On the other hand, the element of time may be introduced and comparisons involving this factor undertaken.

Statistical Method: Frequency Distribution Analysis

The type of analysis which seems best adapted to our problem is known as frequency distribution analysis, and the analytical work to be undertaken in the following chapters will follow this method. The three principal kinds of distributions that will be analyzed are: (1) distributions showing numbers of concerns by earnings ratios, (2) distributions showing percentages of total investments by earnings ratios, and (3) distributions showing numbers of concerns by changes in earnings ratios between successive years. The analysis of

these distributions will be undertaken with respect to both time and space comparisons.

The study of the various aspects of these distributions without respect to time constitutes what we have called space comparisons. For instance, we shall discover (1) whether these distributions exhibit a concentration of frequencies around some central earnings ratio, (2) whether they are symmetrical or asymmetrical, (3) whether much or little difference exists between the individual earnings ratios and the central or more usual earnings ratio, (4) whether, in terms of the variability of earnings ratios, there is much or little concentration around the central earnings ratio (i.e., whether the distributions are peaked or flat-topped), and finally (5) whether the distributions as units can be characterized in terms of given curve types. Each of these characteristics is described in statistical terminology by the words central tendency, skewness, dispersion, kurtosis, and curve type.[8]

The spatial aspects of our problem will lead us to consider (1) whether the earnings ratio distributions are all similar in respect to the five characteristics just enumerated, no matter from what industry they are drawn and without reference to time as a variable, or (2) whether differences exist between the distributions for different industries with respect to these characteristics. The time aspects of our problem require that we discover (1) whether the successive yearly distributions from the same industry show any specific pattern of change with respect to the five characteristics, and (2) whether there is any relationship between these changes, if they exist, when the sequences of distributions in different industries are compared with each other. Furthermore, the time aspect of our problem requires that we discover the relationships which exist between the various aspects of the distributions as temporal change takes place. For instance, what relation-

[8] For the detailed discussion of these statistical concepts and their specific measures, consult pp. 57–59.

ship exists between changes in the mean and in skewness, or between changes in the mean and in kurtosis?

In the development of such an analysis, it will be possible to add to our knowledge of these distributions by studying their internal structure. For instance, does the size of the firms affect their positions within the distributions? Or, introducing the time element, do the various concerns keep the same rankings within the distributions from year to year? Or, although the distributions are similar, do the concerns shift about within the distributions from year to year? In addition, it will be possible to make distributions based upon the various measures derived from each of the distributions for individual industries. For instance, we may have, for a series of years, distributions of numbers of concerns by earnings ratios for a dozen or so different industries. From each of these distributions we can secure median earning rates which, when placed in frequency distribution form, will show the number of industries experiencing the different rates of earnings. The same procedure could be applied to any other measure derived for the different industries and the distributions thus developed can be analyzed in the manner already outlined.

Advantages of the Frequency Distribution Type of Analysis

Since we seek some understanding of the character of the causes which determine the differences in earnings ratios, or the pure profits of different concerns in the same industry or different industries, our study of the frequency distributions of earnings ratios for individual concerns in a given industry will allow us to compare not only the averages for a given industry but the entire frequency distributions of net earnings ratios for different industries. Even if we desired merely to compare the average earnings ratios of different industries, a study of the frequency distributions of individual concerns in those industries by earnings ratios would be necessary, since only through such a study could we decide which average was representative of the earnings ratios

in that industry. We have indicated, further, that several types of distributions are to be studied. We shall study the percentages of total investments associated with different rates of earnings when these earnings are computed on the basis of net earnings to total investment as well as the distributions in terms of numbers of concerns associated with different rates of net earnings to total investment. From such distributions, we shall determine, as previously outlined, the most representative average, the skewness, the kurtosis (i.e., concentration), and, finally, the correlation between the rankings of the different concerns in successive years.

Furthermore, the forces which bring about *changes* in the earnings of an industry will be studied by constructing frequency distributions showing the number of concerns experiencing specific changes in net earnings ratios between successive years. The characteristics of these distributions will be extremely helfpul in suggesting the nature of the causes which bring about the changes in the earnings ratios. Frequency distributions of this type will be associated, in a two-way frequency table, with the distributions showing the net earnings ratios in the first year, so as to discover whether any regressive tendency is present. Another correlation problem will arise from a comparison of changes in net earnings ratios between successive years and percentage changes in total investment. Such a correlation analysis will help us in criticizing the reliability of the data, as well as suggesting the relationship between these two variables.

The frequency distribution analysis will be applied to the study of the relationship between the average earnings ratios of different industries, since frequency distributions will be constructed showing the number of industries experiencing different net earnings ratios. From such distributions, we will discover whether the earnings of the several industries were distributed normally about zero profit or whether more industries made positive profits than negative every year. Furthermore, we will discover whether the distributions of these average earnings showed a greater concentration than

would be shown by the normal curve. In addition, we will be able to find out whether the different industries maintained the same position with respect to the average rate of earnings for all industries when we consider the successive yearly distributions. If the frequency distributions of average earnings for each industry are normal from year to year, this fact will suggest that the deviation of any one industry from the average earning rate in any year was merely a chance deviation. On the other hand, if the same industry ranks high in successive years, this fact will require some explanation other than chance. If the concentration of average earning rates is higher than would be true of normal distributions, the influence of competition will be indicated.

Basic Importance of Frequency Distribution Analysis

The extraordinary development, during recent years, of time series analysis, and its application to business and economic problems, has placed in comparative obscurity the study of frequency distributions. The desire of the economist and the statistician to deal with data in such a manner as to throw light upon typical patterns of change in economic reality (whether these changes are of a cyclical or seasonal character) has led him to deal with time series only. By adopting this approach, the stable aspects of variable measurements are brought out merely as functions of time. The frequency distribution in the universe underlying time series has been almost completely neglected. There are, of course, certain dangers in such procedure. Time series are frequently nothing but averages taken in their temporal succession. If successive averages of this type are to be used by the economist and the statistician for interpreting changes and connections among phenomena, then the averages used must be representative of the universes of variation from which they are drawn.

It is not difficult to find examples illustrating the meaning and significance of these observations. A series of prices of coal taken for each given unit of time is significant only be-

cause, and in so far as, it is a representative average of a number of prices charged in a particular country or a particular district. In like manner, any measure of earnings for an industry in a given country or region at a given time is significant only in so far as it is representative of the earnings in that industry at that time. The same observation is true of time series relating to production. An economist who studies pig-iron output is often not really interested in the absolute amount represented by the series. What he may be concerned with is the question whether production has risen or fallen during the preceding month or year. This total change in the time series is a compound of changes in the output of the various individual concerns in the industry. Whether the change has occurred in only one or two big establishments, or in all establishments, is highly significant for any economic analysis that is to be based on the observation of change. It becomes evident, therefore, that in the interpretation of changes pictured by a time series, the economist must keep in mind the statistical nature of the universe for which this series is a sequence of averages or totals.

This interpretation of time series, even though there may be cases in which the frequency distribution basis of approach is not obvious, is a very useful one. To convince ourselves of the usefulness of the concept, we might think of time series which are not based on variable universes composed of a sum of units, but are restricted to one unit. For example, what would be the significance for time series analysis of the price established by a monopolistic concern for its product when considered over a number of years? From the point of view of the statistician and the economist the answer is clear. The time series has little significance, if any, unless the price is made up not only by the monopolistic concern, but also by the numerous individuals who may be buying from it. A record of events which are not dependent upon the combined action of a number of units (forming a statistical universe), but are the result of decisions of single units, are not statis-

tical but rather are legal, or historical records, or what you will. Even though we take such a thesis in a milder form, and say that not all but a large number of time series are actually successive averages of the variable statistical universes underlying them, the significance of a frequency distribution study of the universes still remains. Of what use is it to know that the average earnings of a given industry, the average price of a given commodity, or the average cost of production of that commodity, rose one per cent, when we are not sure what type of representation such averages give us? Furthermore, suppose that the underlying universes from which such averages are drawn do not persist in time. If, under these conditions, we relate these averages one to another we are really comparing items that are not comparable. This statement applies not only to the different averages of the same series, but to any comparison between successive averages of different series. The use of correlation to measure the association between time series has little significance, therefore, unless we know that the universes from which the successive averages in each series are drawn remain unchanged, and, in addition, are certain that the averages selected are representative of these underlying universes.

An example illustrating the contention just stated is afforded by a problem assigned to a class in statistics at the University of Pennsylvania. The class gathered retail food prices for two commodities (bread and sirloin steak), for fifty-one cities, in the various months of the year 1927. The prices of these two commodities were then formed into frequency distributions of fifty-one items for each month of the year. The bread price distributions were fairly normal. The sirloin steak price distributions were markedly skewed to the right. Under these conditions, then, the better central measure for the sirloin steak prices in each month was the median and not the arithmetic mean. Indeed, the difference was so great that for some months a comparison of the medians showed a decline in the price of sirloin steak, while the arithmetic mean showed a rise. It is easy to see, therefore, not

only that an arithmetic mean would not have *represented* the movement of sirloin steak prices, but that any correlation between such an average price for sirloin steak and for bread during the year would have had little or no significance.

An additional illustration may help to clarify this point still further. If, during a certain unit of time, the averages of the prices of both bread and sirloin steak increased five per cent, this would mean concurrence only in case the representative character of both the average bread price and the average sirloin steak price was maintained through the comparison; i.e., that the frequency distribution type of bread prices was the same before and after the five per cent rise, and that the same was true of sirloin steak prices. In addition, it is necessary to note that the proper central value (i.e., average) would have to be chosen. Otherwise, a change of the same description and proportion in the averages of the prices of both bread and steak is far from signifying a perfect concurrence.

The frequency distributions of rates of earnings to total assets that are to be analyzed in the following chapters will supply abundant evidence to support these general contentions. A question might arise, however, as to why the frequency distribution approach has been neglected in the past if its advantages are so apparent. While several reasons might be suggested, two are of particular pertinence. The first and most obvious reason is that there are very few series available that would give distributions of economic units of sufficient size to make studies of this sort possible. The second reason, the weight of which depends upon the outlook of the investigator, might be derived from the usual assumption of economic theory that such distributions, if studied, would only reveal a high degree of clustering, if not actual identity of units with the average.

With regard to the former of these reasons, it will be recalled that we suggested, at the very beginning of the chapter, that the lack of inductive material on profits might be traced either to the hypothetical nature of the economist's

concept of profits or to the paucity of data. We have seen why the concept of profits presented certain difficulties, and our analysis of statistical procedure has indicated that we might experience some difficulty in securing the data we described as necessary for any analysis. We need mention only a few of these obstacles to make perfectly clear the difficulties involved in obtaining the necessary data. While earnings for a given industry or even for the individual concerns in that industry might be obtained, the value of the total investment employed would be difficult to determine. Each concern would have its own accounting procedure. It would be necessary to go over the balance sheets of each concern and attempt to put them on a comparable basis. Even when this had been done, many reasons might be found for viewing with skepticism the comparability of the figures computed. Such data as can be had, therefore, are usually drawn from a very limited field, and when data are available at all, they are usually just in process of becoming available and their increasing availability is the result of the development of certain agencies of control.

All students of economics are familiar with the general assumption implied in the second reason noted above, and illustrated by the statements that the same product can sell in a given market for one price and one price only; that earnings for different industries tend toward equality, since capital moves to those industries offering the higher returns; and that wages for a given type of labor tend toward equality within any given market. If such statements are interpreted to mean that there are no reasonable or rational grounds for expecting statistical variations in empirical data, then there is little incentive to search about looking for variable distributions of such non-varying units. Time series analyses, however, have now advanced sufficiently to drive home the significance of such studies; and newer interpretations of economic theory, which divide the subject matter of economics into a theory of equilibrium and a theory of variation,[9] have in-

[9] L. Robbins, *An Essay on the Nature and Significance of Economic Science*, pp. 63-67.

creased the need for extending statistical analysis to a study of the variable universes from which economic measurements are drawn. When some attempts have been made to overcome the lack of data, this type of analysis will probably develop very rapidly. One outstanding contribution in this field is the work of Frederick C. Mills.[10]

The present study represents an attempt to apply this type of analysis to earnings ratios. Earnings ratios have been selected because there happens to be available a body of material which can readily be subjected to the analysis and because, moreover, economic theory appears to some persons to imply that little variation in earnings is to be expected. Personally, the writer believes that economic theory, if interpreted correctly, does not indicate that variability will be absent when measurements of economic data are grouped in frequency distribution form.[11]

[10] F. C. Mills, *The Behavior of Prices.*

[11] The reader who wishes to gain a general insight into the scope, general methodology, and major conclusions of the study without reading the technical sections should consult the preface for suggestions outlining an advantageous procedure.

CHAPTER II

ECONOMIC NORMS AND EMPIRICAL VARIABILITY

In the preceding chapter we attempted to outline the economist's concept of profits, and in addition to suggest a statistical approach to an analysis of earnings ratios that would aid in the formulation of a theory of profits. The statistical approach favored was that of frequency distribution analysis rather than time series analysis, and the reasons for this preference were stated in full. It is the purpose of the present chapter to furnish additional background which will indicate the essential ideas behind the approach and the technical methods to be used in the analysis.

General Statistical Ideas

Variability in Economic Theory and Statistics

In Chapter I it was suggested that economic theory does not in reality deny the existence of variability. In support of this expression of a personal viewpoint, it is necessary to indicate the attitude which the writer takes with regard to the construction of normal equilibriums in economic theory. We mentioned economic norms in our analysis of the concept of profits, and the point which we attempted to make when describing these norms was merely this: the normal equilibriums of economic theory arise from considering the limiting tendencies of given sets of forces, if these forces are allowed to work themselves out without disturbance. Furthermore, the theory makes assumptions with regard to the character of the institutional framework within which these forces are liberated. For this reason the equilibriums generated must be interpreted in terms of the theory of limits, and each equilibrium considered to be the limiting condition necessarily re-

alizable only under a set of preestablished conditions. The concepts and terms employed in economic theory have no exact counterparts in historical reality. They serve merely to give form to and establish relationships between various *aspects* of economic behaviour.

Such an interpretation of economic theory places no obstacles in the way of a belief in variation when economic phenomena are measured and related to historical time. Since this point was developed to some extent in the first chapter, we need not deal further with it here. We must now show, however, how the statistical ideas about variability are related to the norms of economic theory.

Variability, as viewed by the statistician, is an empirical phenomenon arising in his experience with measurable data. Whenever a method of measuring data is devised he finds that the values of these measurements show variation. Statistics as a science has for its subject matter the quantitative measurement of mass phenomena when the mass phenomena consist of homogeneous units. From the variable measurements of the homogeneous units making up the mass phenomena, statistical theory attempts to establish significant connections which, from the scientific point of view, mean repeatable connections. The technique which statistical theory devises for the elucidation of its purpose are known as statistical methods.

Economic theory, in setting up normal equilibriums, neglects certain factors which are known to give rise to empirical variability. This procedure is perfectly permissible so long as the purpose is to analyze the complete working out of certain sets of factors in order to arrive at some conclusion with respect to their equilibrium tendencies as limits. The actual process by which such equilibriums are attained—or, in other words, the central tendency of the forces—is not analyzed from the standpoint of variability but from that of their limiting tendency only.[1]

On the other hand, let us assume that economic theory

[1] See A. de Pietri-Tonelli, *Traité d'Économie Rationnelle*, pp. 2–3, section 3.

also attempts to analyze the process by which equilibriums are realized. The variations describable *a priori* will not necessarily correspond to the measured variability appearing in time. Variability as it appears in time may arise out of many factors not present or predictable when the economist began his analysis. Forces excluded from the analysis or not contemplated because of their unpredictable nature may give rise to an empirical frequency distribution of variations not descriptive of the set of forces which the economist wishes to analyze. We would be in a much better position, however, if the economist made some suggestions as to the type and extent of the variations that might be expected under certain prearranged conditions. If such a theory of *a priori* variability existed, then it could be compared with the empirical variability and would afford some guide to the interpretation of the actual forces present in economic reality.

A set of *ideal* theoretical universes of variations based upon certain known conditions influencing the data is the basis of practically all experimental procedure. If a physicist wants to find the length of a rod, his experimental procedure is based upon the assumption that under an established and unchanging set of conditions, the rod has one and only one length. He wants to secure as close an approximation to this ideal length of the rod as possible. He knows, however, that any procedure he may adopt to measure its length will give variable results, because of the errors involved in reading the micrometer or other measuring instrument. If the errors thus introduced are merely the result of variations of this type, then he knows that a series of such measurements will be fairly well described by a normal probability curve. Suppose, however, that the empirical results deviate from the normal curve by an amount so large that it cannot be explained in terms of probable errors of sampling. His immediate reaction involves a search for some cause other than the variable cause of measurement differences. Perhaps this rod has a high expansion coefficient with temperature changes, and during the course of the investigation a *consistent* error has been

introduced. Experimental control will be exercised and one possible factor after another eliminated, until his results agree with his expectations or some reason develops to make it necessary to change his theoretical expectations. When the distribution is of the expected type, then the length of the rod is defined in terms of the central tendency of the variations. In this case the mean is the most probable value of the length of the rod, as well as the *mathematical expectation* of the experimenter.

It is perfectly obvious that the economist cannot follow this procedure, since the degree of experimental control that he can exercise is almost negligible. Therefore, the norms of economic analysis can seldom be defined in terms of empirical variability. Nevertheless, a knowledge of empirical variability, if analyzed in the light of some theoretical and logically consistent hypothesis, may aid us in distinguishing the various factors in economic reality which bring about results that are important if we wish to describe or control these happenings. With these few words of interpretation regarding the relationship between empirical variability and economic "norms," we pass on to the analysis of empirical frequency distributions, always bearing in mind that the central tendencies of these distributions at any one time or over a period of time are not direct approaches to the norms of economic theory.

The Normal Curve and Its Assumptions[2]

As a basis for the development of statistical methods, statistical theory may be said to proceed in the following manner: first, it constructs a set of ideal variable universes in which the variation is developed mathematically from a set of given and precisely defined conditions. Such ideal patterns of variation, or frequency distributions, as they are generally called, can then serve as models which show the precise con-

[2] See H. L. Rietz, *Mathematical Statistics*, Chapter II; and G. Udny Yule, *An Introduction to the Theory of Statistics*, eighth edition, revised, Chapter XV. The writer also desires to acknowledge his indebtedness to Simon S. Kuznets, whose notes on this subject constitute the main elements in the following development.

struction of a set of causes producing variation around a stable result. Having obtained sets of such models, we can determine which are important for carrying out the purpose of statistics as a science, by noting whether observed distributions of empirical data can be described by these models. This procedure necessitates the development of certain technical methods for determining whether the ideal curves "fit" the empirical data with which we are dealing. Finally, statistical theory must establish the conditions which are necessary if, from the fit of the ideal curves, it is possible to imply that the causal universe underlying the empirical distribution is the same as the causal universe from which the ideal curve is derived.

The order of the statistical ideas just outlined is best illustrated by the theory of frequency distributions of one variable; and, since it is the purpose of this outline of statistical methods to prepare the way for an analysis of such distributions, we shall follow this order. It is important to remember, however, that, as has been noted above, the theory of frequency distributions of one variable underlies whatever applications statistical theory has to correlation and time series.

We begin our analysis, then, with the development of the ideal scheme that underlies the so-called "normal frequency curve." There are two approaches to this development: (1) the probability approach, and (2) the theory of error approach. The probability approach, which contains the ideas of interest to us, is based upon hypothetical conditions of the following character:

1. Given a situation in which we know a set of possible effects in all their variety;
2. We also know some essential causes which operate to determine the effects when the latter are taken *en masse;*
3. Finally, we know that, besides the permanent causes, there are variable causes which we cannot ascertain precisely but about which we can make the assumption that they are numerous and that they are distributed

in such a way as not to affect the stable causes materially.

A simple example of conditions of this type may be developed from the familiar example of penny-tossing. If we have n pennies which are to be tossed N times, it is possible to show that the three conditions enumerated above are approximated. Since we are going to toss the n pennies N times, we know that in any one toss we can secure the following possible combinations: n heads, $n-1$ heads, $n-2$ heads, . . . , $n-n$ heads or n tails. In N trials we could secure N times any one of these possible combinations. We know, then, a set of *possible* effects in all their variety. Furthermore, we know that a penny approximates a homogeneous disk of such character that unless it is tossed above some putty-like substance, it can come to rest only after a fall, with either head or tail up. Since any one trial is independent of previous or future trials, we say that heads are just as likely to turn up as tails. Thus we have the essential cause—a homogeneous disk of such character that when at rest after a fall it can only be "heads up" or "tails up," and these possibilities are equally likely and independent.

Finally, we know that the actual position realized after any tossing of the penny is the result of numerous other causes, i.e., the particular motion of the hand, the elasticity of the substance on which the penny falls, the currents of air which develop during the tossing, and so on. These causes we cannot ascertain exactly, *but we know enough about them* to be willing to make the assumption that they are numerous and distributed in such a way as not to affect the stable cause materially.

A curve descriptive of these conditions arises out of the familiar binomial expansion of $N(p+q)^n$ when $p=q=\frac{1}{2}$ and when n becomes indefinitely large. Professor Yule shows how this expansion gives rise to the following equation of the normal curve:[3]

[3] G. Udny Yule, *op. cit.*, pp. 301–302, section 9.

$$y = y_0 e^{-x^2/2\sigma^2}$$

when

y = frequency
x = interval of the independent variable
y_0 = maximum ordinate
σ = standard deviation
e = constant 2.71828

The mathematical deduction of the normal frequency-distribution curve sketched above was contingent upon the condition that $p = q = \frac{1}{2}$. In addition it was assumed that the probability, p, remained constant throughout, since the result of any one toss was independent of other tosses. Finally, the number of independent events was assumed to be large.

It might be well to point out, however, that these conditions can be made somewhat less rigid, although the essential widening of the basis of deduction really requires an approach through the theory of errors rather than the theory of probability. On these possibilities, Yule says:[4]

> The deduction may be generalized, whilst retaining the same type of proof, by assuming that p and q are unequal (provided $p-q$ be small compared with $\sqrt{npq}$, cf. §3), that p and q are not quite the same for all the events, and that all the events are not quite independent, or that n is not large, but that some sort of continuous variation is possible in the values of the elementary variables, these being no longer restricted to 0 and 1, or to other discrete values. (Cf. the deduction given by Pearson in ref. 13.) Proceeding further from this last idea, the deduction may be rendered more general still, without introducing the conception of the binomial at all, by founding the curve on more or less complex cases of the theory of sampling for variables instead of for attributes. If a variable is the sum (or, within limits, some slightly more complicated function) of a *large number* of other variables, then the distribution of the compound or resultant variable is normal, provided that the elementary variables are independent, or nearly so (cf. ref. 6). The forms of the frequency-distributions of the

[4] G. Udny Yule, *op. cit.*, pp. 306–307.

elementary variables affect the final distribution less and less as their number is increased: only if their number is moderate, and the distributions all exhibit a comparatively high degree of asymmetry of uniform sign, will the same sign of asymmetry be sensibly evident in the distribution of the compound variable. On this sort of hypothesis, the expectation of normality in the case of stature may be based on the fact that it is a highly compound character—depending on the sizes of the bones of the head, the vertebral column, and the legs, the thickness of the intervening cartilage, and the curvature of the spine—the elements of which it is composed being at least to some extent independent, i.e., by no means perfectly correlated with each other, and their frequency-distributions exhibiting no very high degree of asymmetry of one and the same sign. The comparative rarity of normal distributions in economic statistics is probably due in part to the fact that in most cases, while the entire causation is certainly complex, relatively few causes have a largely predominant influence (hence also the frequent occurrence of irregular distributions in this field of work), and in part also to a high degree of asymmetry in the distributions of the elements on which the compound variable depends. Errors of observation may in general be regarded as compounded of a number of elements, due to various causes, and it was in this connection that the normal curve was first deduced, and received its name of the curve of errors, or law of error.

The Pearsonian Family of Curves[5]

In fields other than that of economic behavior, the fact that the normal curve did not afford a good description of certain types of empirical distributions led to the development of other ideal curves, designed to afford a larger variety of model descriptions. The set of curves to be used in the analysis of the data which we shall introduce later was developed by Karl Pearson and is known as the Pearsonian Frequency Curves. These curves, it is important to point out, were not, with one exception, developed from a set of

[5] See H. L. Rietz, *op. cit.*, pp. 50–60; W. P. Elderton, *Frequency Curves and Correlation*, second edition; Truman L. Kelley, *Statistical Method*, Chapter VII; and Karl Pearson, *Tables for Statisticians and Biometricians*, pp. lx to lxx.

previously constructed and logically founded causal universes. The Pearsonian curves are based upon the introduction of certain arbitrary quantities in the equation for the normal curve, so as to give curve types that will describe certain empirical distributions. They are, therefore, with the exception of Type III, merely empirical curve types, and the criteria of their type can be interpreted only in terms of deviations from the normal curve, or from Type III.

Pearson begins with the formula for the normal curve, which is

$$y = y_0 e^{-x^2/2\sigma^2}$$

and in which, the mean of x under this condition is equal to zero. Since y represents the frequencies, we can express the relative increase in y with respect to x by taking the first derivative of y with respect to x and dividing by y. In this way we secure, according to the rules of calculus, the following expression:

$$\frac{1}{y}\frac{dy}{dx} = -\frac{x}{\sigma^2}.$$

Analyzing the meaning of this equation for the relative increase in y with respect to x, we see again the condition of the normal curve. When x is negative, the expression is positive, i.e., the frequencies increase so long as we remain on the left hand side of the mean and move toward the mean. At the mean, where $x = 0$, the expression is equal to zero, so that there is no change in the frequency. When x becomes positive, the whole expression becomes negative, i.e., instead of a relative increase in frequency, there is a relative decline. Since the relative rate of change is zero when $x = 0$, and the change is from relative increase to relative decrease, this is the maximum ordinate in the curve. As a result of this analysis, we see that in the normal distribution the mean, median, and mode coincide.

Pearson's system of frequency curves is derived from a modification of the above formula to allow for skewness,

which is merely a divergence between mean, median, and mode. The significance of this development may be described as follows:

$$\frac{1}{y}\frac{dy}{dx}=\frac{a-x}{b_0+b_1x+b_2x^2}$$

is the expression which Pearson uses for deriving his family of curves. It is to be noted that instead of x in the numerator we have $a-x$. This means that the maximum point in the curve frequencies will not be reached when $x=0$, but when $x=a$. Hence, obviously it is possible that the mode and the mean will not coincide (not being given for the same value of x). The term a in the numerator is then an expression which allows for skewness.

The expression in the denominator is still more important. We have noted that in the normal frequency curve the expression in the denominator is a constant. In the Pearsonian differential equation it is a function of an increasing power of x. The fact that it ends with the second power of x is a matter of convenience. Logically speaking, we could have in the denominator an infinite series in terms of the rising power of the x.

Something about the possible values of x can be derived if we assume, as a condition, that the denominator becomes zero. In order to equal zero, obviously x must equal either

$$\frac{-b_1+\sqrt{b_1^2-4b_0b_2}}{2b_2} \quad \text{or} \quad \frac{-b_1-\sqrt{b_1^2-4b_0b_2}}{2b_2}.$$

If we analyze these values of x, we shall be able to find the condition under which the whole denominator becomes zero, and also the condition in which the rate of change becomes infinite.

The solution of this problem, as noted above, is a solution for the roots of x in a quadratic equation. The first clue is the expression under the radical. If the expression under the radical is positive, then both

$$\frac{-b_1+\sqrt{b_1^2-4b_0b_2}}{2b_2} \quad \text{and} \quad \frac{-b_1-\sqrt{b_1^2-4b_0b_2}}{2b_2}$$

are real values, i.e., the roots of x are real. If b_1^2 is smaller than $4b_0b_2$, then the whole root is obviously an imaginary quantity and the roots of x are imaginary or complex.

This gives us the first test or criterion of the Pearsonian curves, i.e., the criterion

$$\kappa_2 = \frac{b_1^2}{4b_0b_2}.$$

Obviously, if κ_2 is positive but less than one, then $b_1^2 < 4b_0b_2$, and the roots are imaginary. If κ_2 is positive and larger than one, then $b_1^2 > 4b_0b_2$ and the roots are real. If κ_2 is negative, the same is true and the roots of x are real.

Under what conditions does κ_2 become zero? When $b_1 = 0$. We shall see later that b_1 also gives the value for a in the numerator. Therefore, when κ_2 is zero, b_1 is zero, a is also zero, and the curve becomes a symmetrical curve. This condition is true of three of the Pearsonian curves, one of which is the normal curve of error. We obviously get the normal curve of error if we assume that not only b_1 but also $b_2 = 0$.

This analysis describes the broad mathematical basis of the Pearsonian curves and of the various criteria. The value of b_1 and its sign, in view of the connection later to be shown which it has with a, yields us a measure of skewness. κ_2 distinguishes for us the types of curves by the types of the quadratic equations in the denominator, which obviously determine the exact function which y forms of x. The two main possibilities are: first, obtaining imaginary roots; second, obtaining real roots. And in the latter case, the two distributions are given by the sign of the κ_2.

We have now completed our discussion of that part of statistical theory which concerns itself with the construction of a set of ideal images. Our next step is to find how we can determine which ideal image affords the best description of any sample of empirical data with which we are dealing. In

other words, we must discuss the method to be used in determining which of the ideal curve types will give us the best representation of our empirical data. Furthermore we will, in addition, develop the meaning of certain statistical measures derived from the empirical data. This problem necessitates a consideration of a method for computing the constants in the equation for the ideal curves from a given empirical distribution. While several such methods have been developed, we shall use only one—the method of moments.

Method of Moments

W. P. Elderton defines the nth moment of a particular frequency as "the product of the frequency and the nth power of the distance of the frequency from the vertical about which moments are being taken."[6] Having secured the moments of the empirical curve, we secure the constants in the curve to be fitted by equating the sum of the empirical moments to the sum of the moments of the ideal curve. There are various methods for computing the moments of an empirical distribution, but we shall indicate only the method followed in this study. The items for each distribution are placed in an array. The values of the items, therefore, can be interpreted as deviations from zero as origin. Since the constants in Pearson's differential equation require, in most instances, the computation of the first four moments, each item is squared, cubed, and raised to the fourth power. The sums of the original items, of the squares, the cubes, and the fourth powers, are then obtained and divided by the number of items. These values constitute the first four moments about zero as origin. To obtain the desired constants, it is necessary to secure the first four moments about the mean as origin rather than zero as origin. This is easily done by applying the formulas necessary to correct the moments and give them in the desired form.

We can illustrate the general method as follows: Let $x_1, x_2, x_3, \ldots, x_n$ equal the values of the individual items and

[6] W. P. Elderton, *op. cit.*, p. 14, section 4.

let ν_1', ν_2', ν_3', and ν_4' represent the first four moments about zero as origin. Then

$$\nu_1' = \frac{\Sigma(x_1 + x_2 + \cdots + x_n)}{N} = \text{mean}$$

$$\nu_2' = \frac{\Sigma(x_1^2 + x_2^2 + \cdots + x_n^2)}{N}$$

$$\nu_3' = \frac{\Sigma(x_1^3 + x_2^3 + \cdots + x_n^3)}{N}$$

$$\nu_4' = \frac{\Sigma(x_1^4 + x_2^4 + \cdots + x_n^4)}{N}.$$

We are desirous of obtaining the first four moments about the mean. Let ν_1, ν_2, ν_3, and ν_4 represent these moments. The relationship between the mean (M) and the assumed origin (zero) can be described by the formula

$$M = o - d$$

and so the necessary correction d is the value of the mean. We have then

$$\nu_1 = \nu_1' - \nu_1' = o$$

$$\nu_2 = \nu_2' - (\nu_1')^2 = \sigma^2 \text{ (where } \sigma = \text{standard deviation)}$$

$$\nu_3 = \nu_3' - 3\nu_1'\nu_2' + 2(\nu_1')^3$$

$$\nu_4 = \nu_4' - 4\nu_1'\nu_3' + 6(\nu_1')^2\nu_2' - 3(\nu_1')^4.$$

Since these moments are computed from ungrouped data, no correction for grouping need be made; the moments computed in this manner constitute the values required to obtain the necessary constants in Pearson's differential equation.

The Constants of the Pearsonian Differential Equation

In terms of moments the constants in Pearson's differential equation can be written as follows:

(1) $$a = \frac{-\sqrt{\nu_2}\sqrt{\beta_1}(\beta_2 + 3)}{2(5\beta_2 - 6\beta_1 - 9)}$$

$$b_0 = \frac{\nu_2(4\beta_2 - 3\beta_1)}{2(5\beta_2 - 6\beta_1 - 9)} \tag{2}$$

$$b_1 = \frac{\sqrt{\nu_2}\sqrt{\beta_1}(\beta_2 + 3)}{2(5\beta_2 - 6\beta_1 - 9)} \tag{3}$$

$$b_2 = \frac{2\beta_2 - 3\beta_1 - 6}{2(5\beta_2 - 6\beta_1 - 9)} \tag{4}$$

where

$$\beta_1 = \frac{\nu_3^2}{\nu_2^3} \tag{5}$$

and

$$\beta_2 = \frac{\nu_4}{\nu_2^2} . \tag{6}$$

When the broad mathematical basis of the Pearsonian family of curves was outlined, we developed a criterion which we called κ_2 and defined in terms of certain relationships between the constants in the differential equation as they appeared under the radical in the solution for the roots of the equation. This relationship was stated as follows:

$$\kappa_2 = \frac{b_1^2}{4b_0b_2} .$$

On the basis of this criterion, Pearson outlines his three main types of frequency curves in accordance with the following principles:

If $\kappa_2 < 0$ i.e., negative, we have a Type I curve (roots real).
If $\kappa_2 > 0 < 1$ we have a Type IV curve (roots imaginary).
If $\kappa_2 > 0 > 1$ we have a Type VI curve (roots real).

When stated in terms of moments κ_2 can be written as follows:

$$\kappa_2 = \frac{b_1^2}{4b_0b_2} = \frac{\nu_2\beta_1(\beta_2 + 3)^2}{4\nu_2(4\beta_2 - 3\beta_1)(2\beta_2 - 3\beta_1 - 6)} \tag{7}$$

$$= \frac{\beta_1(\beta_2 + 3)^2}{4(4\beta_2 - 3\beta_1)(2\beta_2 - 3\beta_1 - 6)} .$$

We can now analyze this criterion to see when it takes the value zero. This value is possible when the value of the numerator is zero. The numerator can be zero only if β_1 is zero; and that this is possible we can see from equation (5) above when the third moment about the mean (ν_3) is zero. The third moment about the mean will be equal to zero under the condition of symmetry only, so that $K_2 = 0$ defines the necessary conditions for symmetrical distributions. It follows, therefore, that curve Types I, IV, and VI are asymmetrical distributions. Pearson's system provides three symmetrical frequency curves, Type II, Type VII, and the normal curve. These three curves are distinguished by the value of β_2. The curve is normal when both b_1 and b_2 are equal to zero, since the differential equation for the normal curve is $\frac{1}{y}\frac{dy}{dx} = -\frac{x}{\sigma^2}$ and thus contains only one constant, which is in the denominator. The Pearsonian differential equation will contain only one constant in the denominator if b_1 and b_2 are both equal to zero. It will be shown later that if b_1 is equal to zero, a is also zero, so that a will disappear when b_1 disappears. These conditions being established, it becomes evident that if b_2 is equal to zero, then from expression (4) above we have:

$$2\beta_2 = 3\beta_1 + 6 \tag{8}$$

and since, for all symmetrical curves,

$$\beta_1 = 0$$

then

$$\beta_2 = 3$$

for the normal curve. When, β_1 being equal to zero, $\beta_2 < 3$, we have a Type II curve, and when $\beta_2 > 3$ we have a Type VII curve.

Pearson's curve Types III and V arise as special deviations from the normal curve. When b_2 equals zero, but b_1 is not equal to zero, we have a Type III curve which indicates that this curve is merely the skew binomial. The obvious

criterion which meets these conditions is

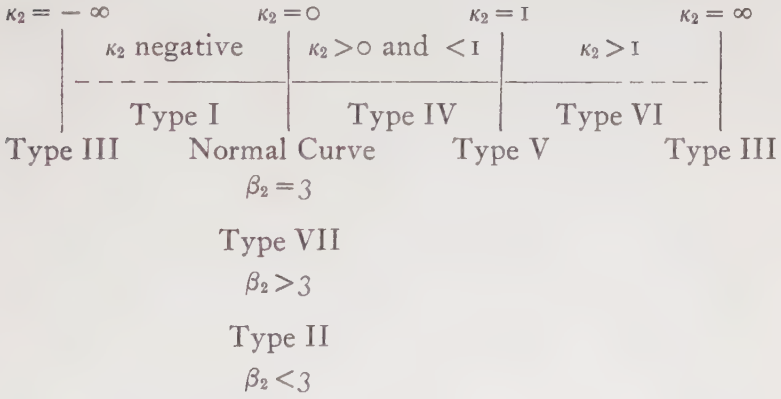
$$2\beta_2 = 3\beta_1 + 6.$$

Hence we can write

$$\kappa_1 = 2\beta_2 - 3\beta_1 - 6 = 0 = \text{Type III curve.}$$

We secure a Type V curve when $\kappa_2 = 1$. Both curve Type III and V are skew deviates of the normal curve.[7]

The following graphical device illustrates the several curve types described above.[8] Certain other types arise for particular values of β_1 and β_2, but the above description gives the essential curve types.



It should also be noted, before closing this brief description of the Pearsonian curve types, that Type I curves can adopt U, J, and twisted J forms for values of β_1 or β_2 beyond certain limits. Type VI and Type III curves can also take J shapes for β_1 and β_2 values which are greater than certain specific values. We have already indicated that when β_1 is greater than zero it constitutes a measure of skewness, since it is equal to zero when ν_3 is zero, and greater than zero when ν_3 is a positive or negative quantity.

[7] For an interesting and instructive interpretation of these two curve types consult Truman L. Kelley, *op. cit.*, Chapter VII, particularly sections 40 and 41.

[8] Adapted from the chart by W. P. Elderton, *op. cit.*, p. 50.

When we described the general meaning of the Pearsonian differential equation, we found that the constant a in the numerator allowed for skewness and measured the difference between the mean and the mode for skew distributions. A comparison of the values in moments of a and β_1 in expressions (2) and (4) above, shows that they are equivalent except for sign. Since this is true, we can derive a measure of skewness in coefficient form from this knowledge. Pearson calls this measure χ.

$$\chi = \frac{x-a}{\sigma} = \frac{0-a}{\sigma} = \frac{\sqrt{\nu_2}\sqrt{\beta_1}(\beta_2+3)}{\sqrt{\nu_2}2(5\beta_2-6\beta_1-9)} = \frac{\sqrt{\beta_1}(\beta_2+3)}{2(5\beta_2-6\beta_1-9)}.$$

This measure and β_1 (when taken as a measure of skewness) are given the sign of the difference (mean-median). In all other formulas given above β_1 is taken as positive in sign.

Interpretation of Pearsonian Curves: β_1, β_2, and κ_1 Criteria

The interpretation of Pearson's curves may be approached from two angles. The first is that of treating any type as a deviate either from the normal or from the Pearsonian Type III, which, like the normal probability curve, has a definite logical basis. The logical basis of the normal probability curve is outlined in the preceding discussion. It may be expressed briefly as follows: in the normal distribution each contributory cause group is independent; each cause group is of equal valency; and each cause group contributes with equal frequency results in excess and in defect of its mean contribution. The conditions which satisfy a Type III distribution are that (1) the contributory cause groups shall be independent, and (2) they shall be of equal valency. Each cause group, however, need not contribute with equal frequency results in excess and in defect of its mean contribution. Type III corresponds to the skew binomial.

We can interpret any of the curve types descriptive of our data from the point of view of its deviation with regard to either skewness or kurtosis from the normal distribution, or with regard to the size of the κ_1 criterion as compared with

zero for the Type III curve. β_1 yields the measure of skewness as compared with the normal curve, β_2 yields the measure of kurtosis, and κ_1 gives the measure of the degree by which a given type differs from Type III.

The explanation of why β_1 is a measure of skewness has already been developed, as has also the interpretation of κ_1 as a measure of deviation from Type III. In addition, we should note that when κ_1 is negative we secure a Type I or Type II curve, while if κ_1 is positive we secure a curve of Type IV, V, VI, or VII. The value of β_2 as a measure of a characteristic of frequency distributions relates to the kurtosis or concentration of the distribution.

We have shown that the value of β_2 for the normal curve is equal to 3. Examining the formula for β_2 (expression (6) above), we see that it is a measure of the relationship which the second moment squared (σ^4) bears to the fourth moment (ν_4). The relationship in the normal curve is such that the fourth moment is three times as large as the square of the second moment. Since the standard deviation (σ) is a measure of dispersion, we see that the larger the fourth moment in terms of the standard deviation, the greater is the degree of concentration about the mean as central tendency. If, therefore, $\beta_2 > 3$, we know that the concentration of the data is greater than would be found in a normal curve with the same standard deviation. Frequency distributions having values of β_2 greater than 3 are said to be more peaked than a normal curve, and this characteristic allows us to describe them as leptokurtic. When a frequency distribution gives a value of less than 3 for β_2, it is said to be platykurtic, or less peaked than a normal curve with the same standard deviation.

The interpretation of β_2 as a measure of kurtosis must be made cautiously. We can, as has been indicated, say that a frequency distribution having a $\beta_2 > 3$ shows a concentration greater than would be found in a normal curve with an equal standard deviation. If, however, we are comparing a J shaped curve with a normal curve, the meaning that can be

given to such a statement about peakedness is very limited. Furthermore, the comparison of the size of β_2 for different empirical distributions of different types, and characterized by different degrees of skewness and dispersion, has little or no meaning. Different distributions of the same curve type, and characterized by similar skewness and dispersion, can be compared with each other as to kurtosis, since they can both be compared with the same normal curve. It is only under this last condition that comparisons as to kurtosis for varying curve types can have any very specific meaning.

Interpretation of curve types in terms of their deviations from the normal curve or Type III, is, however, rather limited, being of a negative character; i.e., we arrive at a conclusion that a curve is not normal, or that it is not Type III. We can say nothing further regarding the nature of the underlying universe, except that it must differ from the nature of the universe underlying either the Gaussian curve or the Type III curve. But there is another way of interpreting the curve fitted to the distribution, that is, through the test of the moments.

Interpretation of Pearsonian Curves: Stability of Type

Moments, when taken from the mean, measure the successive powers of deviations from the mean weighted in each case by the frequency. As we take moments of higher and higher order, it is the x^n which changes, the f (frequency) remaining the same. In other words, we are measuring increasing powers of the deviations (x) from the mean, weighted by one and the same frequency. In some curves the moments become large as one raises the power of x, but they will not become infinite unless one takes an infinite power. In other curves the moments become infinite at a rather low power of x. This statement, of course, applies to the *ideal curves* and not to the *empirical set of data*, since in a given set of data the moments will always remain finite.

In studying the power at which moments become infinite, one can learn a great deal about the stability of the type of

distribution. If moments become infinite only at an infinite power of x, then obviously the distribution type is quite stable. If the moments become infinite at a low power of x, an instability in the distribution is indicated. The measure of the power at which the positive moments in a given curve become infinite is given by the expression $r = \frac{6(\beta_2 - \beta_1 - 1)}{2\beta_2 - 3\beta_1 - 6}$. If r is 7, the eighth moment is infinite.

In other words, the $r+1$ moment is an infinite moment. The r is significant as a measure of the power at which the positive moment becomes infinite only if it is positive.[9] If r is negative, then the distribution type has no infinite positive moments. Inspecting the expression for r, we see that its denominator is the κ_1 criterion, which is zero both for the normal curve and the Type III curve. Obviously, for these two curves the moments become infinite only when the power of the moment is infinite. In other curves r is obviously a real quantity, since the denominator is either larger or smaller than zero. If it is smaller than zero (i.e., negative) then the distribution is either a Type I or Type II curve and has no infinite positive moments. While curve types falling above the Type III line (see Chart X, page 146) do not have infinite positive moments to exclude them from legitimate description among the Pearsonian Curve Types, other aspects of these curve types have been criticized when they are used for descriptive purposes. R. A. Fisher has shown[10] that the curves of the Type I variety are not efficiently located and scaled by the method of moments. All J curves fall beyond what Fisher calls the "region of validity" of the first moment. The upper boundary of the region of validity of the second moment is set by the line $r = -4$. This upper boundary is not established because the probable errors of the positive moments become infinite, but because "the ratio of the probable

[9] "For a point above Type III [i.e., κ_1 being negative] no positive moments are infinite and for a point below Type V no negative moments . . . are infinite." Truman L. Kelley, *op. cit.*, p. 126.

[10] R. A. Fisher, "On the Mathematical Foundations of Theoretical Statistics," *Philosophical Transactions*, 1921, A. ccxxii. 309–368.

errors of the moments to the probable error of the corresponding optimum statistics is great and tends to infinity as the size of the sample is increased."[11]

Summarizing these general aspects, we know that if r is positive and 7 or smaller, then the eighth or the lower positive moments will become infinite. When this happens the distribution is said to be of a type to which no Pearsonian curve will give a good fit, i.e., it falls in the heterotypic area (see Chart X, page 146). The reason is that the standard error of any moment involves twice the power of the moment (ν_{2n}) since $\sigma_{\nu n} = \sqrt{\frac{\nu_{2n} - \nu_n^2}{N}}$. The Pearsonian curves involve the computation of the fourth moment, and if the eighth moment becomes infinite the value of the fourth moment has no reliability, so that for r positive and 7 or less, no Pearsonian curve is indicated. On the other hand, if r is negative and numerically equal to 4 or less the indications as to curve type are not reliable if the reasons given by Fisher are accepted.

In this connection, it is important to point out that a Type III curve does not involve the fourth moment, since for Type III $b_2 = 0$, and the value of β_2 may be derived from β_1 in the equation $2\beta_2 = 3\beta_1 + 6$. Hence, since β_2 has no independent value, we do not need the fourth moment, which is involved in the computation of β_2 as an independent value. By the same reasoning, it is to be seen that the normal curve involves only the first and the second moments, i.e., the mean and standard deviation. We say, then, that the two most stable curves are the ones which involve moments of the smallest power as compared with the other curves.[12]

In order to interpret r as a measure of instability in the distribution, we extend our analysis of this concept. Professor Mills,[13] offers some pertinent suggestions as to the meaning

[11] See also R. A. Fisher, *Statistical Methods for Research Workers*, 2nd ed., which exemplifies this method.

[12] For a discussion of negative moments and the stability of the normal, Type III, and Type V curves when viewed in terms of negative and positive moments, consult Truman L. Kelley, *op. cit.*, Chapter VII, sections 37, 38, 40, and 41.

[13] F. C. Mills, *op. cit.*, pp. 318–323.

and significance of the term "stable frequency distribution." Some of his suggestions may be reviewed with advantage at this point. A frequency distribution represents the resultant of a large number of separate forces. If these forces are not correlated, and no one force exerts a preponderant influence, something approaching stable equilibrium will be secured in the frequency distribution. The perfect example of such conditions would be represented by that curiously universal pattern, the normal curve. When this curve describes an empirical distribution, we know that the forces tending to produce values above the mean are precisely balanced by forces pulling in the other direction. The balancing of diverse forces under these conditions allows us to foretell, within limits capable of precise estimate, the exact proportion of observations which will depart by given amounts from the mean value.

It is from such conditions of balanced forces that we derive the principal ideas connected with stability of type. A stable frequency distribution may be thought of, then, as one which embodies such balanced conditions. There is variation, but the forces of disruption are held in check by cohesive agencies. The population from which the distribution in question is drawn is not subject to "sport" types departing from the norm in amounts which are excessive in terms of the standard deviation of that population. Sporadic variation plays, in perfect balance, within assignable limits. Stability of type is thus generated by the balance of forces responsible for individual variation. We see, then, that stability is a group characteristic.

If a distribution of the normal type is an example of stability, it may be assumed that departures from that type indicate the presence of some unstable elements. A Type III distribution is based upon conditions very close to those which give rise to the Gaussian type, since Type III corresponds to the skew binomial.

The above comments suggest some of the causes which result in instability of type, as that phrase is here used. Un-

stable elements may be present when essentially homogeneous data are subject to the interaction of factors too limited in number or of such marked inequality that certain forces exert a preponderant influence. A statement of Yule, quoted above,[14] indicates that the latter of these two possibilities seems to offer the best explanation of the instability of distributions of economic data. In addition to these two, a third possibility of accounting for instability exists. Correlation between the factors affecting the quantity measured tends to destroy the balanced condition of stability. Professor Mills says: "Probably the most important of the conditions which give rise to departures from Type III, as well as from the normal type, is this factor of dependence of the contributory causes or, in Kelley's phrase, of 'uncompensated correlation between the cause groups.'"[15]

In addition to the type of instability shown by skew variation in homogeneous material, we may have the instability which arises when the data classified consist of heterogeneous materials. Under these conditions, the various groups mixed may be subject in their variation to essentially different forces. This fact would ordinarily give rise to curve types departing materially from the normal curve. Professor Pearson has shown, however, that the mere fact that an empirical distribution can be described by a normal curve is not sufficient proof of the homogeneity of the data, and in addition that departure from the normal type is not necessarily evidence of heterogeneity.

Whenever distributions depart from the normal type, there is some loss in both the significance and the reliability of the statistical measures descriptive of the population represented. As a result, the sampling errors may become so large that there is no assurance that a second sample from the same population will yield a distribution of the same type as the first sample. We have shown above that r as a measure of stability of curve type is based upon the fact that if r is

[14] See pages 40–41.
[15] F. C. Mills, *op. cit.*, p. 320.

positive and 7 or less, the eighth moment or lesser moments become infinite, and hence the standard error of some of our criteria which involve the eighth moment becomes so large that no reliance can be placed upon the descriptiveness for other samples of the curve type derived for this one, or if r is negative and numerically 4 or less little reliability can be placed upon the curve type indicated. These ideas will need to be borne in mind when we come to the analysis of our data, since it will be extremely important to determine, if it is possible to do so, whether the distributions of earnings ratios seem to contain elements which make for instability of type.

Attributes of the Frequency Curve: General Discussion

Our previous discussion of the Pearsonian family of curves has already indicated certain fundamental characteristics of frequency curves. In general, these attributes are discussed under four main headings—Central tendency, Dispersion, Skewness, and Kurtosis. To these four categories we add a fifth—Curve Type. In the normal curve three measures of central tendency—mean, median, and mode—coincide. From the standpoint of probability, the mean is the measure of greatest mathematical expectation, while the mode is the most probable value. The mean is located at the center of gravity of the distribution. The median is the item having a value midway among all of the individual values and divides the area of the distribution into two equal parts. The mode is the value which occurs most often, i.e., has the maximum frequency. If a system of variates is so distributed that their natural values give a skew distribution, but the logarithms of these values give a normal distribution, then the geometric mean of the natural values corresponds to the arithmetic mean of variates distributed normally on the basis of their values in natural numbers.

If the distribution is not symmetrical, the mean is pulled away from the mode and the median falls between these two values. The distance between the mean and the mode is the

basic idea underlying measures of skewness. The difficulties in the way of calculating the modal value forces the adoption of the differences between mean and median as the principle measure of skewness. The mean-minus-median measure of skewness, when expressed as a percentage of the standard deviation, is in coefficient form, and the degree of skewness of two distributions with unequal means can thus be compared. We have already indicated two other measures of skewness, β_1 and χ, and shown how they are to be interpreted. In this study, we have sometimes been desirous of obtaining a measure of skewness where the mean, β_1 or χ, could not be computed. In most of these cases, it was possible to compute the median and the quartiles so that Professor Bowley's measure of skewness was used.[16] This measure is expressed as follows: $Sk = \frac{q_2 - q_1}{q_2 + q_1}$, where q_2 is the excess of the upper quartile over the median, and q_1 the excess of the median over the lower quartile. This measure can take values within the limits of ± 1 and a value of .1 suggest a moderate degree of skewness, and .3 a considerable degree. The sign indicates the direction of the skewness.

Various measures of dispersion have been devised, but the standard deviation (σ) is the one in general use. This measure is merely the square root of the second moment about the mean, and for the normal curve it has a definite meaning, since approximately sixty-seven per cent of the variates around the mean will fall within the $\pm$ limits as defined by this measure. For other distributions it is merely a measure of the degree of variation about the mean, and if expressed in coefficient form by dividing it by the mean, it enables us to compare the extent to which distributions with unequal means vary with respect to their dispersion. The data to be analyzed later were not always in such form as to allow the computation of this measure, so that substitutes in the form of either the inter-quartile range, or the inter-quartile range divided by the median, are used.

[16] A. L. Bowley, *Elements of Statistics*, fourth edition, p. 116.

Kurtosis, as a characteristic of frequency curves, refers to the peakedness or flat-toppedness of the curve, and we have already developed its measure and the manner of its interpretation. Finally, as we have noted, we may classify the distributions in terms of certain previously defined curve types. In the case of the normal curve and Type III, we know the logical foundation on which these curve types are constructed. For the other Pearsonian curve types, we merely know a method of (1) graduating the distributions, (2) interpreting them in terms of their deviations from the normal or Type III curve, and (3) analyzing them in terms of the stability of the causal universe from which they were drawn.

Persistence of Frequency Curve Attributes

Our present undertaking contemplates a study of the persistence of these attributes in both space and time. This task, if it is to be successfully completed, demands that we make a study of these measures as derived from distributions of earnings ratios for different industries, note persistent traits in space and time, and interpret them. In addition, we must study their variation in time with respect to each other, or with reference to some measure characterizing the general disturbances that take place in the course of time. Some of the questions which we must attempt to answer are these: Without respect to time, are all of the distributions symmetrical or asymmetrical? If they are asymmetrical, do they show skewness which is unvarying as regards sign? Do the earning rates show a consistently large or small dispersion? Are the greater part of the distributions leptokurtic or platykurtic? Are the central tendencies approximately of equal size for all years, or do they show a high degree of variance? Are all distributions characterized in terms of a single curve type? Does the sign or degree of skewness change with changes in the mean? Does the dispersion for different distributions vary, and if so is there correlation between the dispersion and the mean or the dispersion and skewness? Further preliminary enumeration is not necessary, since the

general nature of our problem has been sufficiently indicated.

Aims of the Inquiry

Having outlined the task to be attempted, we may now state our aims. We are not undertaking a study of statistical methods or technique. Our sole purpose is to analyze empirical earning power, with the idea of offering some suggestions for the construction of a theory of profits; and every attempt will be made to emphasize interpretation and to reduce the actual statistical presentation of material and discussion of technique to a minimum. The present chapter, by force of necessity, has dealt with statistical methodology; but from this point on, our attention will be focused on the interpretation of the data in terms of their theoretical import. The first chapter called attention to the need for inductive material as a basis for the correction of old theories or the formulation of new theories of profits and noted the difficulties which must be overcome. To repeat, we propose to study the material now to be analyzed, in order to gain an insight into the nature of the forces in economic reality which bring about profits.

Data to be Analyzed: Their Advantages and Disadvantages

Samples Used

The materials which we shall analyze are taken from the following sources: (1) Federal Trade Commission reports on specific industries; (2) data on earnings in the Public Utility Industry, furnished by courtesy of the Business Research Bureau of the University of Illinois; (3) *A Source Book for the Study of Industrial Profits*, issued by the United States Department of Commerce; and (4) statistical appendices to the first volume of *The Shifting and Effects of the Federal Corporation Income Tax*, issued by the National Industrial Conference Board.

The materials taken from the Federal Trade Commission

reports cover earnings for eleven different industries for a period of from two to four years. For all of these industries, except one,[17] the Commission reported the rate of earnings for each individual concern in the sample. The following outline gives the names of the different industries covered and the number of yearly distributions for each industry, as well as the number of concerns included in each year.[18]

1. Shoe Manufacturing—1914 to 1917, inclusive, and 1919. 238 concerns for the years 1914, 1916, 1917; 237 concerns in 1915; 341 concerns in 1919.
2. Tanning Industry—1914 to 1917, inclusive, and 1919. 52 concerns in 1914 and 1916; 53 concerns in 1915 and 1917; 56 concerns in 1919.
3. Steel Industry—1915 to 1918, inclusive. 78 concerns for the years 1915 to 1917, inclusive; 91 concerns in 1918.
4. Wheat Flour Milling—1919 to 1922, inclusive. 101 concerns in 1919 and 1922; 105 concerns in 1920; and 107 concerns in 1921.
5. Crude Petroleum Industry—1918; and 1922 to 1925, inclusive. 134 concerns in 1918; 76 concerns in 1922; 83 concerns in 1923; 90 concerns in 1924 and 1925.
6. Petroleum Refining Industry—1922 to 1925, inclusive. 58 concerns in 1922; 60 concerns in 1923; and 63 concerns in 1924 and 1925.
7. Southern Pine Lumber Industry—1917 and 1918. 156 concerns in 1917, and 144 concerns in 1918.
8. Stove Manufacturing Industry—1920 and 1921. 78 concerns in each year.
9. Retail Hardware Stores—1920 and 1921. 70 concerns in each year.
10. Retail Furniture Stores—1920 and 1921. 355 concerns in each year.

[17] The one exception relates to the data on the earnings of the Retail Furniture Stores. In this instance a frequency distribution of number of stores by earnings ratios in five per cent class intervals was given.

[18] For the specific titles of the reports used and references to page and table numbers, consult the footnotes to Table I, Appendix B.

11. Washing Machine Manufacturing—1920 and 1921. 35 concerns in each year.

These materials supplied thirty-seven yearly distributions of concerns by earnings ratios. In addition, it was possible to obtain or compute average earnings for a series of years for the individual concerns in six of the industries. The industries for which this was possible were: Shoe Manufacturing—average earnings for 1914 to 1917, inclusive, 237 concerns; Tanning Industry, 1914 to 1917, inclusive, 51 concerns; Steel Industry, 1915 to 1918, inclusive, 78 concerns; Wheat Flour Milling, 1919 to 1922, inclusive, 108 concerns; Crude Petroleum Industry, 1922 to 1925, inclusive, 76 concerns; Petroleum Refining Industry, 1922 to 1925, inclusive, 58 concerns. With the addition of these distributions by average earnings ratios, we secured 43 distributions in all.

In general, the computation of the earnings ratios for individual concerns by the Federal Trade Commission was the ratio of net earnings to investments in the particular business. Net earnings were generally taken to mean the earnings of the business unit, less operating expenses and returns from other outside investments. Interest on the funded debt and federal taxes were generally included in the net earnings. The investment in the business was generally taken to include capital stock, surplus, undivided profits, and other appropriated surplus accounts, less certain assets, such as good will. In Appendix A, Part I, an explanation of the specific method of calculating the ratios for each industry reviewed is quoted from the particular Federal Trade Commission report from which the data were derived. In addition, Appendix A, Part I, contains the necessary information with regard to the method which the Federal Trade Commission used in collecting these data, and, where possible, the Commission's estimate of the representativeness of the sample.

The data for the Public Utility Industry were derived from a series of bulletins published by the Bureau of Business Research of the University of Illinois and from certain addi-

tional data in greater detail supplied to the writer by the courtesy of the bureau.[19] The data utilized most completely in this study were the detailed ratios provided by the bureau. Since these ratios were merely more extensive than those in the published tables in Bulletin 15, our best approach to an understanding of these data is through this report. The description of the procedure in the bulletin is as follows:[20]

> In preparing the ratios here studied the balance sheets of some two hundred public utility companies were examined for the period of 1915–1924. These financial statements yielded 1603 cases for study. For 87 of these, no statement of net income was obtainable. In addition there were eight cases between .11 and .16 in which the ratio of Net Income to Total Assets was unusually high, and two cases in which the ratio of Net Income to Total Assets was unusually low, −.11 or less. These 97 cases were regarded as irregular and excluded from further analysis. The remaining 1506 cases were classified into ratio-groups with one per cent intervals, as .01–.019, .02–.029, etc.

This quotation explains the method followed by the bureau in obtaining the data for the construction of frequency distributions of net income to total assets.[21] The bureau was also interested in reporting the distributions of net earnings

[19] The particular bulletins by number and title are:

Bulletin No.	*Titles*
9.	The Current Ratio in Public Utility Companies.
10.	The Productivity Ratios of Public Utility Companies.
13.	The Disposition of Income in Public Utility Companies.
15.	The Earning Power Ratios of Public Utility Companies.
18.	Property Investment in Public Utility Companies.
20.	The Source of Public Utility Capital.
26.	Standard Financial Ratios for the Public Utility Industry.
27.	The Financial Plan of Gas Companies.
35.	The Financial Plan of Electric Light and Power Companies.
37.	The Operating and Earning Power Ratios of Gas Companies.
42.	Operating and Earning Power Ratios of Electric Companies.

[20] *The Earning Power Ratios of Public Utility Companies*, Bulletin No. 15, pp 5–6; Urbana, Bureau of Business Research, University of Illinois, 1927.

[21] The total assets were corrected so as to exclude outside investment. The income from these investments was also excluded from the net income.

to total assets, net earnings being net income plus fixed charges. The data on this ratio were derived as follows:[22]

> For this ratio there were 146 cases which, for one reason or another, were considered unsuitable for inclusion in the chart and tables. For example, in 81 cases no Income Statement was reported along with the balance sheet, and in 43 cases there was an operating loss; that is, the revenue was insufficient to cover operating expenses, to say nothing of fixed charges or a return to investors. For the most part, these cases of operating losses were scattered as to years and as to companies concerned. In only one company were there as many as seven consecutive years of operating loss; in four companies there were three to five consecutive years of loss; in five companies two years, and in nine companies one year of loss.
>
> In a few more cases there were unusually high ratios which were too few in number to be included. There were 22 cases in all with a ratio of .16 or more: 13 had a ratio of .16 to .19 inclusive, 8 had a ratio of .20 to .30, and 1, a ratio of .33. A total of 1457 cases were left to be classified into ratio-groups and set up into a frequency distribution.

The appendix tables in this bulletin presented distributions of net earning and net income ratios for all the years combined and for the individual years 1917, 1919, 1921, and 1924. Being desirous of obtaining the individual yearly distributions, particularly for the net earnings ratio distributions, the writer requested the use of the original data, which the bureau kindly supplied. These data were in the following form:

Name of Company	Information	Years (Individually from 1915 to 1924 incl.)	Type of Company	Location
	Ratio of Net-Earnings to Total Assets			
	Ratio of Net-Income to Total Assets			
	Total Assets			

[22] *The Earning Power Ratios of Public Utility Companies*, p. 9.

Some or all of the data were supplied for 195 different companies for some or all of the years indicated above. This should have meant, according to the quotation above, that if extreme items were not eliminated we should have 1522 net earnings ratios (since, from 1603 balance sheets, 81 could not be used because of the absence of income statements) and 1516 net income ratios (since, from 1603 balance sheets, 87 could not be used because of the absence of income statements).

The actual number of cases thus made available, however, gave totals of 1482 net earnings ratios and 1475 net income ratios. Through personal correspondence with Mr. Arthur H. Winakor, the reasons for these discrepancies were accounted for. The bureau had from time to time in the course of its ratio studies, revised the data in the light of new information, and eliminated certain companies or yearly items. For instance, two companies originally included were later found to be almost exact duplicates, so that one was eliminated, and the working sheets for another company were lost. With exceptions of this sort, all of its data were provided by the Bureau of Business Research, and form the basis for the analysis carried out in this study. The frequency distributions in Table II of Appendix B give the individual yearly distributions for the net earnings ratios and show how the cases were distributed over the ten-year period.

Three types of companies were indicated by the bureau: holding companies, gas and electric companies, and traction companies. Their geographical location was indicated by the division of the United States into the four sections—East, Middle West, West, and South. The analysis can, then, take into consideration the influence of type of company and of location.

The material taken from *A Source Book of Industrial Profits*[23] covers earnings in 16 major industrial groups for the years 1919 to 1928, inclusive. In this instance we do not

[23] The tables from the *Source Book* used in this study are noted in Appendix B in conjunction with Table V.

have a record of the earnings of individual concerns, but merely the frequency distributions of earnings by five per cent class intervals for each of the years, a total of 160 distributions in all. The yearly distributions for the years 1919 to 1923 are based on earnings ratios which represent the percentage of total net income to capitalization;[24] while the distributions for the years 1924 to 1928 are based on earnings ratios which represent the percentage of total profits to total capital.[25] These distributions have open ends on the negative side and the extremely high class intervals on the positive end are larger than five per cent. The open ends and unequal class intervals for extreme positive items make it impossible to compute the mean earnings for each distribution. Medians can be computed for all distributions, however, and quartiles for all but two. Accordingly we can compute skewness according to the Bowley formula, and dispersion can be measured by the inter-quartile range, which takes a coefficient form when divided by the median.

The sixteen major industrial groups are divided into four main divisions. These divisions are: (1) manufacturing corporations, (2) trading corporations, (3) mining corporations, and (4) financial corporations. In the manufacturing division 2,046 identical concerns were surveyed in each year; in the group of trading corporations, 664 identical concerns in each year; in the mining division, 88 concerns in each year, and in the financial division, 346 concerns in each year. These

[24] The definitions of these terms given on page two of the *Source Book* are as follows: "*Total net income* is net earnings (after payment of all business expenses and fixed charges including interest on funded debt), but before Federal income taxes; it includes, however, income items which are not taxable, such as dividends received from other corporations and interest receipts upon tax-exempt securities."

"*Capitalization* is invested capital as measured by the total of the following balance sheet items: (i) preferred stock, (ii) common stock, (iii) surplus and undivided profits."

[25] The definitions of these terms given on page three of the *Source Book* are as follows:

"*Total profits* are the sum of *total net income* and *estimated interest upon bonded debt.*" [For all of the data used in this study the estimated interest was five per cent.]

"*Total capital* is the sum of capitalization and *bonded debt.*"

frequency distributions, then, cover 3,144 identical concerns for a ten-year period, or 31,440 company-year cases.

The manufacturing corporations division included eleven major groups, which are enumerated below with the number of corporations included in each group.

Major Group 1—Food
215 concerns
Major Group 2—Textiles
289 concerns
Major Group 3—Leather
54 concerns
Major Group 4—Rubber
26 concerns
Major Group 5—Lumber
190 concerns
Major Group 6—Paper and Pulp
111 concerns
Major Group 7—Printing
100 concerns
Major Group 8—Chemical
210 concerns
Major Group 9—Stone and Clay
114 concerns
Major Group 10—Metal
648 concerns
Major Group 11—Scientific Instruments, etc.
89 concerns

The trading corporation division consisted of three major groups, as below:

Major Group 12—Retail Trade
283 concerns
Major Group 13—Wholesale Trade
292 concerns
Major Group 14—Retail and Wholesale Trade
89 concerns

The third main division (extractive industry) included only one major group, which is given the number 15 and contains 88 concerns.

The fourth division (financial institutions) constitutes Major Group 16 and includes 346 banking institutions.

The fourth body of data to be analyzed was taken from the report of the National Industrial Conference Board[26]

[26] *The Shifting and Effects of the Federal Corporation Income Tax*, Vol. 1, National Industrial Conference Board, New York, 1928. For references to the particular

previously described and covers eleven major industrial divisions in the years 1922, 1923, and 1924. These data merely supply frequency distributions of earnings ratios by ten per cent class intervals for each of these industrial divisions for the three years just enumerated. These distributions are open at both ends. It should be noted, however, that in this instance we have two types of distributions: (1) distributions of numbers of concerns by earnings ratios, and (2) distributions of percentages of total assets by earnings ratios. The eleven major industrial divisions for which these data are presented are outlined below, with the number of concerns included in each division in each year.

1. Food—381 concerns in 1922, 402 in 1923, and 389 in 1924.
2. Textiles—457 concerns in 1922, 477 in 1923, and 454 in 1924.
3. Leather—83 concerns in 1922, 86 in 1923, and 83 in 1924.
4. Lumber—280 concerns in 1922, 284 in 1923, and 271 in 1924.
5. Paper and Pulp—169 concerns in 1922, 171 in 1923, and 165 in 1924.
6. Printing and Publishing—178 concerns in 1922, 181 in 1923, and 171 in 1924.
7. Chemicals—207 concerns in 1922 and 1923, and 198 concerns in 1924.
8. Stone and Clay—127 concerns in 1922, 151 in 1923, and 144 in 1924.
9. Metal—971 concerns in 1922, 981 in 1923, and 946 in 1924.
10. Wholesale Trade—522 concerns in 1922, 526 in 1923, and 503 in 1924.

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tables in this report which are utilized in the study, consult the footnotes to Table VI—Appendix B. It should also be noted that these data are merely a more extensive report on the same body of information (income tax returns) given by the *Source Book of Industrial Profits* for the same years. It is included as an independent body of information because the basis of computations and the presentation of the material are entirely different.

11. Retail Trade—442 concerns in 1922, 462 in 1923, and 453 in 1924.

Remembering that these distributions are open at both ends, we readily see the impossibility of computing the mean earnings for the distributions. It so happens, however, that the distributions of percentages of total assets by earnings ratios were analyzed by the National Industrial Conference Board and the means, medians, and quartiles computed and reported in their publication. For the distribution of numbers of concerns by earnings ratios, we can compute medians, and, in some instances, quartiles. Certain comparisons of these measures will be useful in developing specific points as our discussion progresses.

In this instance the rate of earnings refers to the ratio of "profits" to "total assets." No specific definition for either profits or total assets is given, but the general tenor of the remarks implies that profits mean net income before the payment of interest and federal taxes, while total assets mean the value of all items as found on the balance sheet at the close of the fiscal period.

In addition to these major bodies of data, certain supplementary information will be introduced when it pertains to special points under discussion. In the main, however, the above body of data constitutes the principal materials to be analyzed, and for convenience we shall refer to these materials, from this point on, by using the following designations:

Federal Trade Commission data—Sample 1
Public Utility data—Sample 2
Data from *A Source Book of Industrial Profits*—Sample 3
Data from National Industrial Conference Board Report —Sample 4

Some Existing Studies of Earnings

Before we review the advantages and disadvantages attached to these data which have just been outlined, or con-

sider the merits or demerits of the methods that have been selected to analyze them, a brief review of previous studies and the methods employed in them will be helpful.

During the war and early post-war period considerable attention was attracted to certain cost data which were made available as a result of the price-fixing activities of the Federal Government. In the main, these data were used to give empirical support to certain conceptions of "supply" and "price" in economic theory, but they were often interpreted as affording evidence with regard to profits. In general, the material used represented the average unit costs which were incurred by the various individual concerns in a given industry. These costs were arranged in ascending order, and in some instances plotted with reference to the amount of output or percentage of the total output produced by each concern. This scheme is pictured graphically by Professor Bye in an article reviewing the literature on this material.[27] One of his graphical illustrations[28] is here reproduced as Chart I.

Regardless of whether cost data arranged in this form really represent a supply curve,[29] the suggestions with regard to profits that such data seem to offer are readily apparent. If the average price received for the product produced by the concerns represented in Chart I happened to be $30 (assuming the Y scale to be dollars), then a line drawn from $30 parallel to the OX axis will separate the concerns which sell above and below cost, and also show the percentage of the output produced at cost or below. The area between the top of the rectangles and the price line will represent profit, and is often called "producers' surplus." The area of the rectangles above the price line will represent the losses.

[27] Raymond T. Bye, "The Inductive Testing of an Economic Deduction: A Method Illustrated by Analyses of Marginal Producers and Representative Firms, by Alfred Marshall, Horace Secrist, and Kemper Simpson." In *Methods in Social Science*, pp. 614–634, edited by Stuart Rice; Chicago, University of Chicago Press, 1931.

[28] Raymond T. Bye, *op. cit.*, p. 624.

[29] The writer is of the opinion that such an arrangement of costs does not constitute a supply curve.

If such observations lead to the conclusion that the earning powers of the different concerns are in the same order as their unit costs, then the conclusion may well be in error. Whether the unit costs include or do not include a "normal" interest on the investment, if the sales of the concerns are not in direct proportion to the size of their investments, the largest margin of profits on sales per unit does not necessarily mean the largest return on investment. Ranking the

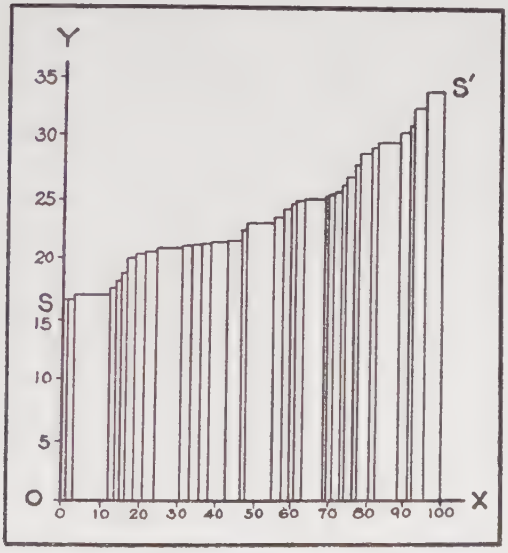

Chart I. Particular Expenses Curve

concerns by the difference between unit price and unit cost does not necessarily indicate the ranking of the earning power of the different concerns. Furthermore, most of the attempts to study the array of unit costs and their relationship to price were by necessity forced to use an average price for the industry. Such an average price may or may not be representative of the individual prices received by the different concerns, and the use of the actual price received may bring about rankings of the different concerns by the difference between unit cost and price entirely different from the rank-

ings secured when an average price is used. It is also evident that the extent of the difference between unit cost and price can not be used as a basis for comparing the earnings of concerns in different industries, since the turnover of the investments of the concerns in different industries is even more likely to vary than the turnover within an industry itself.

Some attempt will be made later in this study to show the relationship that exists between unit costs and the ratios of net earnings to investment. For the present it will suffice merely to indicate that no necessary relationship need exist. If high negative correlation between high cost and high earning power exists, some support is given to the idea that profits are a rent of business ability. This inference would be particularly strong if the industry is one in which the prices received for the product produced are fairly uniform between concerns and there is competition for the agents of production, so that all enterprisers are forced to pay the same price for their productive agents. These conditions lacking, it does not seem permissible to say, with any assurance, that differences in costs are the basis for profits when profits are measured as a percentage of investment. Furthermore, if concerns do not maintain their position with regard to either cost or earning power it is rather doubtful whether such differences can be accounted for in terms of individual or collective management abilities.

A particular example of the use of the ratio of net profits to sales as a basis for studying profits is given in a doctoral dissertation submitted to the faculty of Harvard University by Donald Jackson in April 1932. The title of the dissertation is *Some Aspects of Profits with Particular Reference to Department Stores*. The study contains a very valuable review and criticism of the various profit theories and provides, in the appendix, a valuable survey of the concept of the representative firm. The part that is of particular interest to us, at this point, is the empirical material used and the method by which it was analyzed. Dr. Jackson took the annual reports of finances and operations made by individual

stores to the Bureau of Business Research of the Harvard Graduate School of Business Administration. The bureau had circularized the stores and received reports from them since 1919, but since the material was scanty and incomplete for the early years, Dr. Jackson included only the reports from 1921 to 1929, inclusive. This sample included 4,169 reports for the period. The maximum in any one year was 581 and the minimum 301.

The items used in the analysis were net sales, gross margin, total internal expense, merchandise assets, and inventories. The term "profits," as used in the thesis, comprises net income from operation (outside income excluded) after interest, rent, executive salaries, and taxes were deducted. The interest deducted included a charge for all capital. In terms of the items listed above, net profit is the remainder when total internal expenses is deducted from gross margin. "Total expense" and "gross margin," however, exclude income and expenses not pertaining to the operation of the merchandising business.

Net sales, as the measure of business done, form the basis for expressing all but one of the other series, including net profits. The one exception is inventory, which is expressed as a ratio to cost of goods sold. The analysis of each of these items for each year (1921–1929), and for all nine years together, was carried out. This analysis was fundamentally a study of the simple correlation between each pair of series. The ratio of net profits to sales, as the dependent variable, was correlated with each of the other five factors as independent variables and then the correlation of each pair of independent variables was computed. In the process of correlation, other characteristics of the series were computed, such as means, medians, modes, dispersion (σ), and skewness (q_2-q_1/q_2+q_1).

The emphasis in this dissertation is upon the degree and consistency of correspondence between profits of department stores (net profits to net sales) and other specified items internal to the department-store business. That such

a study is valuable can hardly be doubted, but the limitations of the data are also clearly evident. Profits as a percentage of sales do not make permissible any comparisons between industries, nor necessarily indicate the ranking of earning power (as conceived by the profit concept) for the individual concerns in a given industry. The character of the distributions of the different items included is very interesting, but the computation of all the items with net sales as a base does not allow us to get at the forces (suggested by the concept of profits in economic theory) making for profits. Even if certain internal factors in a given industry are highly correlated with the ratio of net profits to net sales, we cannot say that these factors account for earning power nor that they necessarily imply that the results secured in one industry will hold true in another.

Two other very important publications presenting empirical information on profits are the contributions of William L. Crum[30] and Laurence H. Sloan.[31] These two books have been reviewed rather completely by Ralph C. Epstein[32] and we need here do no more than merely indicate their general scope and purpose.

Corporation Profits, by Mr. Sloan, is based upon the published reports of 455 "industrial" corporations for the years 1926 and 1927. A composite balance sheet and income statement for these corporations and an analysis of various items in these statements are first made. In Chapters V to VII, inclusive, we secure information about: (1) the percentage of gross income saved for net profit; (2) the distribution of net profit among fixed charges, preferred dividends, common dividends, and surplus; and (3) the earnings on invested capital.

The percentage of gross income saved for net profits is given for 235 individual companies in the years 1926 and

[30] *Corporate Earning Power.*

[31] *Corporation Profits.*

[32] "Statistical Light on Profits, As Analyzed in Recent Literature," *Quarterly Journal of Economics*, pp. 320–344, February, 1930.

1927, and the 50 corporations which saved the greatest portion of gross for net in 1927 are studied separately; also a separate study is made of 71 companies out of the 235 which reported less than five and one-half per cent of gross saved for net.

The distribution of net profits is studied in composites for each of the two years and for various major industrial groups, as are the earnings on invested capital. Earnings on invested capital are also reported for the top fifty concerns and the bottom fifty concerns. Chapter VIII and those which follow are concerned with an analysis of various balance sheet items, such as the property account, funded debt, current assets, cash account, etc. The book concludes with a very interesting review of the data on the basis of the grouping of the companies into a so-called "fifty club." The 50 companies enjoying the highest ranking in the various aspects analyzed are given special attention and their appearance in the different lists studied.

Mr. Sloan's book gives us a considerable amount of information about a selected list of corporations. The first limitation of the data is apparent when we remember that only two years, 1926 and 1927, are included. Furthermore, although the information shows clearly the wide difference in the earnings of individual concerns, no matter how computed, limitations of the data do not allow the computation of the characteristics of the distributions of earnings for the different industries. All through the study arithmetic means are used to summarize the composite data, although it is clearly evident that the extreme items present have made these measures non-representative. Do all industries show about the same variation in earnings? Are the mean earnings for some industries influenced more by large negative items while others are influenced by large positive items? For instance, one industry might present a distribution showing high negative skewness, another showing no skewness, while a third might show high positive skewness. In these cases the mean earning rate for each industry might differ materi-

ally, although the modal or median earning rates might be nearly identical.

Professor Crum's book presents the most elaborate and inclusive survey of earnings data available. The basis of the study is found in the *Statistics of Income* reports, and the fortunes of some 455,000 corporations during the period 1916–1927 are subjected to a variety of analyses. Two measures of earning power are used. The first measure is called the "profit ratio" and is approximately the same as the percentage of profits to sales.[33] The second measure is the percentage of profits to total assets, and is called the "earnings ratio."

The profit ratio is computed for the divisions entitled Manufacturing, Trade, Mining, Service, Construction, and Agriculture, as well as for all divisions for each of the years from 1916 to 1927. Then minor groups within the Manufacturing division are analyzed in the same way for all years, as are selected groups from other divisions for the years 1916 and 1926. Chapter VII presents the data on the earnings ratio for the main divisions and Manufacturing sub-groups for the year 1926. This general body of data is used to analyze time changes and relationships, differences among lines of industry, and differences between regions. There are also chapters on the classification of assets and liabilities, fixed charges, successful corporations, amount of net income, and finally a general summary.

The analysis of these data is always cautious and the limitations are clearly set forth. It is these limitations that we are particularly interested in. First, the characteristics of the distributions for which the profit ratios and earnings ratios are averages cannot be determined because the details of the distributions are not known. Second, the profit ratio allows comparisons for the same division or sub-group

[33] As noted by Crum, the ratio is really net profits to gross income. Since gross income included income from sources other than sales but excluded tax-exempt interest, and since Crum deducts corporate taxes from net profits in computing the ratio the accurate definition of the ratio is "the percentage ratio of *net income* minus *income tax* to *gross income*" (p. 5).

at different periods of time, but does not really allow comparisons between different groups at the same time, since the turnover of different industries is materially different. Variations in the relationships between the different groups are, of course, legitimate and important. The earnings ratios are only obtainable for one year, and for this reason it is not possible to discover whether the relationship between profit ratios in time and earnings ratios in time is substantially the same.

For these reasons the data are more important for a study of time variations than for the study of the factors which, in each industry, determine the presence or absence of profits. They do help to point out the changes in relationships in average earnings, but here again, if the different industries have significantly different types of distributions, the comparisons of such averages, while indicating the success or failure of the industry, do not allow an analysis of the reason for the differences which might appear if the entire distribution were available. This factor is clearly pointed out by Professor Crum in section (b) of his appendix, and is mentioned here merely as an illustration of the need for an analysis of the underlying frequency distribution.

Professor Nerlove[34] has utilized the same basic information as was analyzed by Professor Crum, but has centered his attention upon the time changes in such total items as corporate "gross" income and corporate net income and their relationship during the period 1920 to 1929. He does, however, secure an estimate of invested capital for the individual years of the period and so computes the percentage ratios of net incomes to invested capital for this period for all corporations and for four divisions: Mining and Quarrying, Manufacturing, Construction, and Trade. His last three chapters on the disposition of corporate incomes, and particularly Chapter VIII on the compensation of officers, are very instructive.

Here again, however, the underlying distribution cannot

[34] S. H. Nerlove, *A Decade of Corporate Incomes, 1920 to 1929.*

be analyzed, and the interpretation must necessarily be limited as a result of this fact. Professor Epstein,[35] in his article reviewing the books by Mr. Sloan and Professor Crum, made frequency distributions of Sloan's data for the years 1916 and 1917 from the ratios of income to invested capital for the 36 industries. The distributions being based upon only 36 items, and the distributions of the earnings ratios for the individual companies in each industry being unknown, little significance could be attached to such a distribution. The recognition of this fact must have been largely responsible for his willingness to undertake the tedious task of collecting the material which he presented in the *Source Book of Industrial Profits* and which is to be analyzed in this study.[36]

This brief and incomplete review of some of the analyses of earnings data has been presented in an attempt to provide a contrast to the type of analysis which is to be undertaken here. Having examined some of the imperfections of the available analyses *for the purposes which we have in mind*, we must now analyze our own data and note their imperfections for the same purposes.

Advantages and Disadvantages Attached to Our Data

The record of the individual earnings ratios of a large number of concerns for a fairly large number of industries is the principal advantage of the data which we are to analyze. The disadvantage for interpretations as to profits arises from imperfections in the data which cannot be corrected. We have, apparently, the ratios of net earnings to total investments. On the other hand, the items of expense which have been subtracted from the gross earnings in order to secure the net earnings may be far from the proper expenses according to the ideal conditions which are necessary to give us the proper net earnings. The items of depreciation,

[35] "Statistical Light on Profits, as Analyzed in Recent Literature," *Quarterly Journal of Economics*, February, 1930.

[36] Professor Epstein is now preparing an analysis of these data for the National Bureau of Economic Research.

obsolescence, inventory evaluation, and officers' salaries are subject to a large amount of manipulation by individual concerns and may materially alter the size of the net earnings. These items may have taken up all or a considerable part of the profits. The calculation of total investment is even more difficult if the type of result we require is to be correctly realized. The ideal measure of total investment must give the cost value of the assets which are invested in the business as a productive unit. The following list of typical balance-sheet items, if used as an illustration, will indicate some of the difficulties:

TYPICAL BALANCE-SHEET ITEMS

Assets	Liabilities
Cash and bank deposits	Capital stock Common and preferred
Property investment Plant and machinery	Bonds and other long-term indebtedness
Inventories Raw materials, partly finished products, and finished products	Surplus and undivided profits
Accounts receivable	Reserves for depreciation Buildings, machinery, etc.
Notes receivable	Appropriated Reserves Taxes, bad debts, etc.
Prepaid items	Accounts payable
Patents and copyrights	Notes payable
Good-will	Bank loans
Outside investments	

If we assume that the values attached to these items are the average values for the accounting period, we find several alternative possibilities for estimating the correct investment. To begin with, we might select the figures for the sum of all the assets, which will of course correspond to the total liabilities. This selection is clearly subject to certain criti-

cisms. First, since we are looking for the investment in this enterprise, outside investments should be excluded from the assets and the income from these investments should be excluded from the income of this business. J. H. Bliss offers the following suggestion regarding the best estimate of the investment as a basis for earning power calculations:

> The total capital employed should include all the assets used in the production of net operating earnings—cash, accounts receivable, inventories, prepaid expenses, plant investment, deferred charges, and intangible fixed investments. The total capital employed is readily determined by referring to the assets side of the balance sheet. From the total assets of the business should be eliminated only those investments not employed in operations and those which yield separate income, such as investments in income-producing securities.[37]

The writer thinks that this attitude neglects two additional factors which must be introduced if earning power is to be used as the economist uses it. First, certain items such as patents and copyrights represent, in large part, capitalized earnings. Bliss calls them intangible investments, and in a certain sense—particularly the financial sense—this is correct. On the other hand, although expenditures for advertising and the building up of the trade name do enhance the ability of the concern to sell its products at remunerative prices, they do not increase the concern's ability to produce those products. Other concerns could produce these products without the advertising investments, but the concerns that had made such investments would enjoy the monopoly advantage of their advertised products, since, even though the products were exactly alike, the public might not know this. If the advertising expenditures are merely for the purpose of introducing the article, then such expenditures are more nearly necessary investments, but for the most part the writer believes that the economist's concept of investment is more nearly approximated if such items are eliminated from current balance sheets, so that the higher earnings thus

[37] J. H. Bliss, *op. cit.*, p. 89.

realized may appear as the special advantages of monopoly.

Second, even if these items were eliminated, we do not have the best investment estimate because another criterion has to be considered. The weighted average rates of earnings on the investments in each business should equal the rate of earnings for the investments of all businesses combined. The items still present on the asset side of our balance-sheet, if added together for all individual concerns, would contain certain duplications. For instance, the accounts receivable on the balance-sheet of one concern would cancel out the accounts payable on the balance-sheets of other concerns. Professor Irving Fisher has shown that if all balance-sheets are added together, the sum of the assets of all the concerns is nothing but the sum of the physical property items, which is the same as the sums of the total capital equities of each concern less the intangible investments.

If all of these items are considered, the best investment figure appears to be the sum of the capital equities (capital stock, bonded and other long-term debt, and surplus and undivided profits) less intangible assets. This would, in general, be equal to the sum of property investments and inventories, corrected for depreciation and the net differences between current assets and current liabilities.

We may now examine the data to be used in this study of earning power and see how they meet the requirements of the above analysis. In general, the Federal Trade Commission data use as the investment base the sum of the capital equities less the intangible items. The investments for Shoe Manufacturing and Tanning companies were calculated as follows: "The values ascribed to good-will, trade marks and patents, the amounts invested in other enterprises or other corporations, the current liabilities and certain reserves were added together and the sum of these amounts was deducted from the total assets." In this instance the results attained would be very close to the capital equities less the intangible and outside investments. The earnings ratio data for these industries in 1919 took into consideration short-time bor-

rowings and included them as part of the investment. The writer feels that from the point of view of securing the investment figures, this was a mistake. It would be better to exclude the interest paid for such borrowing from the net income rather than to count such borrowing as part of the investment, since the service paid for is a current expenditure.

Since the details of the methods used to calculate the investments for each of the industries taken from Federal Trade Commission sources are recorded in Appendix A, Part I, we need not cite evidence with regard to each industry. The reader can determine by studying Appendix A whether we are correct in our general conclusion that the investment figures used closely approximate the capital equities less the sum of intangible assets and outside investments.

The data on earnings ratios from the *Source Book* are of two types, as previously explained, but are in each instance closely connected with the capital equity concept. The earnings ratios for the period 1919 to 1923, inclusive, are based on only part of the capital equities, namely the stock equities, while the earnings ratios for the period 1924 to 1928, inclusive, are based on investment figures which include capital stock and bonded indebtedness. The difficulties that arise as a result of these differences must be borne in mind when we study the data in detail. One thing in particular must be kept in mind. If the earnings are based on the total capital equities and we secure a ratio of 10 per cent, we must not conclude that the profits to some of the holders of capital equities cannot be larger than this ratio. For instance, if half of the total capital investment is in bonds paying five per cent and the other half is divided between preferred stock paying seven per cent and common stock not specifying any maximum earnings rate, the earnings on common stock will be 23 per cent, although, as we specified, the average earning rate on the total capital equities is only 10 per cent. We think that the correct measure of the earning

power of the concern is 10 per cent, but this does not mean that some of those who have equities in the concern cannot make a higher return than this.

The earnings ratio data for the Public Utility Industry use total assets less outside investments as the investment base, while the National Industrial Conference Board data use the unmodified total assets figures. We would expect, therefore, that the earnings ratios from the last two bodies of data would be lower than those for the first two samples.

We must recognize, therefore, that our data are not at all ideal. Nevertheless, the type of analysis to be used will allow the derivation of useful approximations if within an industry the general methods of accounting are fairly alike. We shall not be able to compare averages for different industries with a high degree of exactness, but the other characteristics of the distributions will be comparable if the condition of similar accounting procedure holds good for the bulk of the concerns in a given industry. Whether all the profits have been reported in the net earnings, or some have been hidden in expense items such as officers' salaries, will not materially affect the shape of the earnings ratio distributions if most of the concerns have done similar things. The averages of the distributions may be too low, but other than this the effect may be negligible for our purpose.

Without attempting to mention all of the objections (since they are legion) that could be offered to show the imperfections of the data used when contrasted with ideal data, we may begin the analysis. When the study has been completed, its significance for profit theory may not be great, but it will afford an analysis of what business men report as earnings and will show how such reports must be improved if from them we are to secure empirical evidence which can be used for the construction of profit theory. Furthermore, the method of analysis will be instructive as an attempt to get at the group forces at work in modern economic society.

In general, then, this material has some advantages over previously published data. The problem of determining the

earning power of individual concerns can best be answered by comparing the earnings as a percentage of the investment in the business. Many previous analyses have been in terms of net income to sales, and this fact vitiates certain aspects of the comparison with regard to the profitableness of different total investments. Other studies have compared net earnings after interest payment with capitalization as represented by capital stock and surplus. Since the extent by which capitalization represents total investment varies for different concerns, the earning power of different investments is not possible of estimation. Most of our data present net earnings, as computed before the payment of interest and federal taxes, as a percentage of the total capital equities. Even here, however, we have noted certain differences in the items selected to represent total investments and net income. The ideal body of data would present only the net income from the particular business as a percentage of the total investment when these investments were valued at their cost of acquisition. Under these ideal conditions, the earnings of equivalent original investments would be obtainable and elements of quasi-rent, interest, and pure profits could be more accurately estimated. The Federal Income Tax requirements have, to some extent, improved the comparability of data gathered from different concerns in the same industry, so that on the whole we believe the data used in this report are as little subject to elements making for non-comparability as could be reasonably expected.

Probably the most significant single advantage of this body of data is to be found in the fact that we have earnings ratios either for individual concerns or number of concerns by different class intervals of earnings ratios. The Federal Trade Commission data and Public Utility data are the best, since they give earnings by individual concerns in each of several successive years. The possibilities of empirical analysis of economic forces will be vastly increased when for each concern in an industry we can secure net income, itemized assets, costs per unit of output, geographical location, selling

price, and other items of equal importance. Until such evidence, computed accurately and on a comparable basis, is available no discussion of the possibilities and methods of rational industrial control is likely to be worth much. The fact that the best bodies of data are to be found in the reports of a controlling agency is indicative of the truth of this general statement.

Another major disadvantage connected with these data, but not yet mentioned, arises out of the fact that in every case our distributions for successive years contain the same concerns. The rise of new concerns and the decay of old ones are thus excluded. We secure a history of those concerns that persist during the interval studied, but information with regard to birth and death in industrial endeavors is lacking. On the whole, this fact probably reduces the extent of variation among the earning rates of different concerns, since the new concerns often have significant advantages, while the dying ones are the most unfit of all.

CHAPTER III

ATTRIBUTES OF FREQUENCY DISTRIBUTIONS OF EARNINGS RATIOS IN SPACE

We shall now attempt to present our findings with regard to Central Tendency, Dispersion, Skewness, Kurtosis, and Curve Type, as they are represented by the various measures which could properly be employed for their analysis. No attempt will be made *in this chapter* to study these characteristics in time, since our attention will be centered upon discovering general similarities or differences. Before these findings are presented, it will be well to call attention to the data in unanalyzed form, so that their general nature and characteristics will be familiar. Tables I to VI, inclusive, in Appendix B present the data for our four samples. In addition, Charts II to IX present frequency polygons constructed from the frequency distributions of Samples 1 and 2. A brief survey of this material will serve as an instructive introduction to the following discussion.

Order and Logic of Arrangement

It might appear that the logical starting point in presenting our measures of these several attributes would be a study of the values of the central tendency for the various distributions. We have already observed, however, that these measures are not strictly comparable among our different samples, nor with regard to Sample 1 are they strictly comparable in all cases among the distributions for the different industries. Furthermore, the selection of the most appropriate central measure must be based upon our knowledge of skewness, and while studying skewness we can obtain all the information we need regarding the relationship between the various central measures. For these reasons, we select skewness as the first attribute to be analyzed.

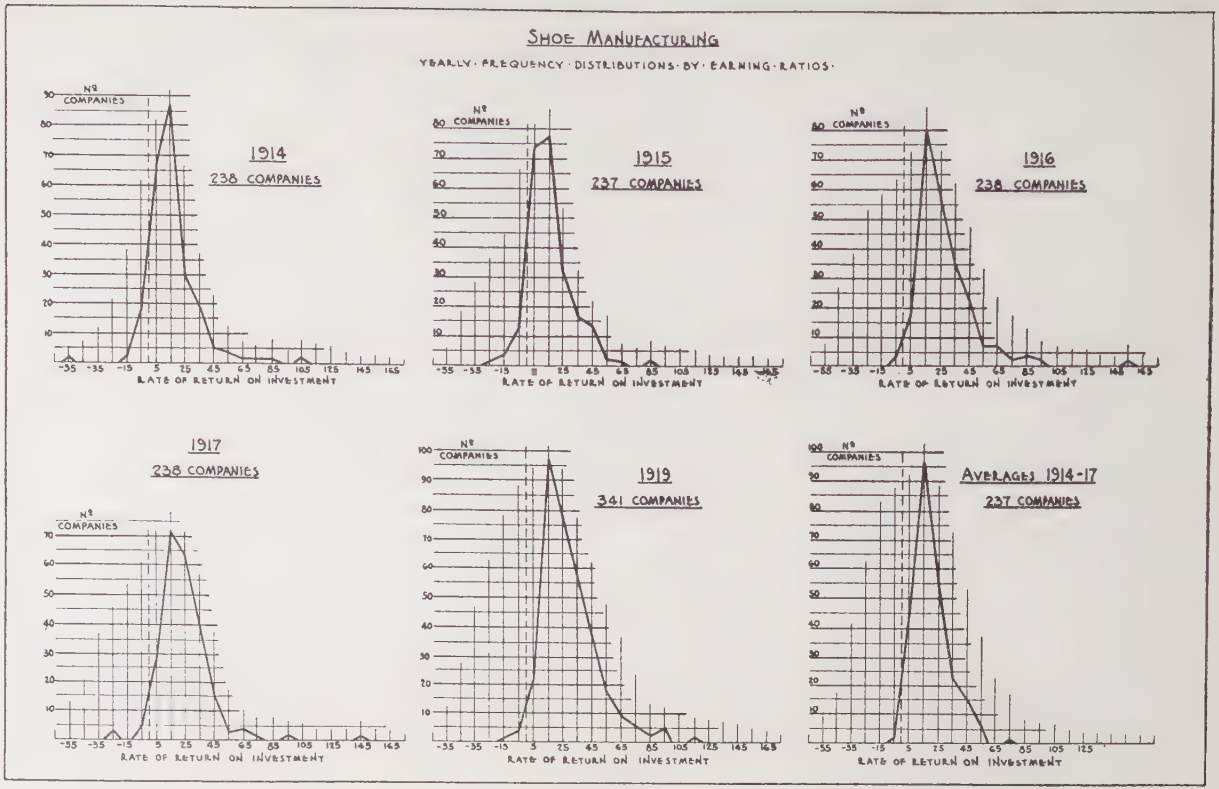
SHOE MANUFACTURING
YEARLY · FREQUENCY · DISTRIBUTIONS · BY · EARNING · RATIOS ·
1914
238 COMPANIES
1915
237 COMPANIES
1916
238 COMPANIES
1917
238 COMPANIES
1919
341 COMPANIES
AVERAGES 1914-17
237 COMPANIES
Nº COMPANIES
RATE OF RETURN ON INVESTMENT

CHART II

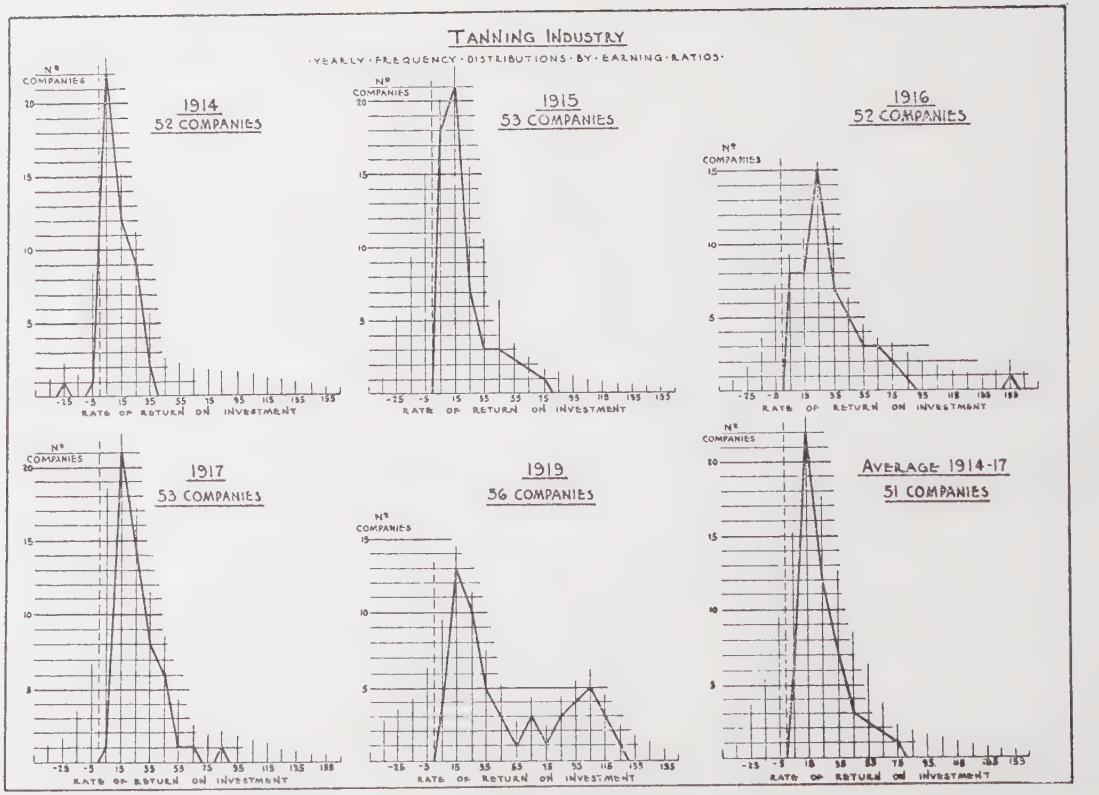
TANNING INDUSTRY
·YEARLY·FREQUENCY·DISTRIBUTIONS·BY·EARNING·RATIOS·
1914
52 COMPANIES
1915
53 COMPANIES
1916
52 COMPANIES
1917
53 COMPANIES
1919
36 COMPANIES
AVERAGE 1914-17
51 COMPANIES
Nº COMPANIES
RATE OF RETURN ON INVESTMENT

CHART III

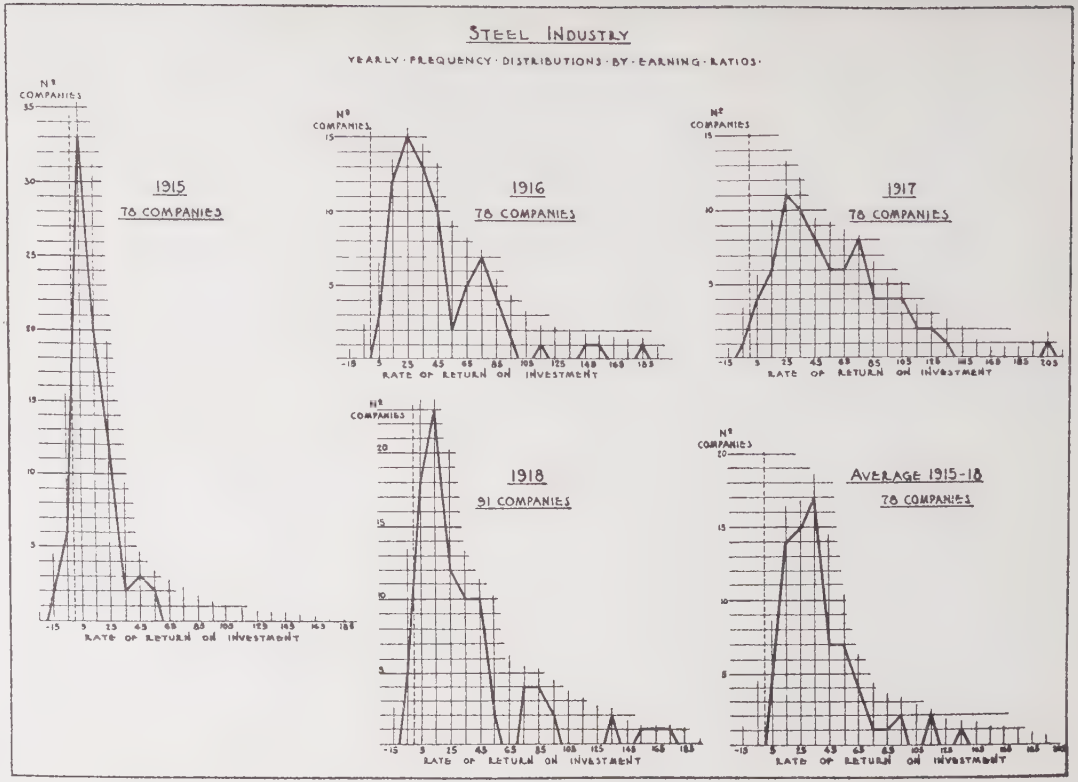
STEEL INDUSTRY
YEARLY · FREQUENCY · DISTRIBUTIONS · BY · EARNING · RATIOS ·
1915
78 COMPANIES
1916
78 COMPANIES
1917
78 COMPANIES
1918
91 COMPANIES
AVERAGE 1915-18
78 COMPANIES
RATE OF RETURN ON INVESTMENT

CHART IV

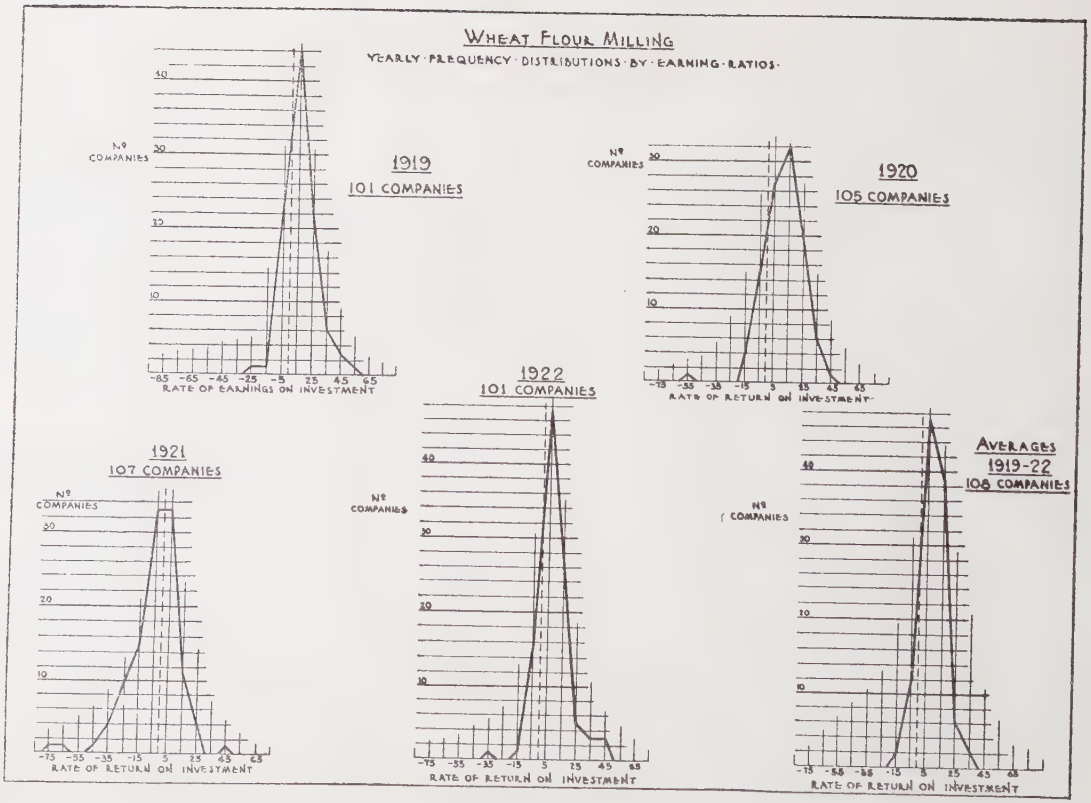
WHEAT FLOUR MILLING
YEARLY · FREQUENCY · DISTRIBUTIONS · BY · EARNING · RATIOS ·
1919
101 COMPANIES
Nº COMPANIES
RATE OF EARNINGS ON INVESTMENT
1920
105 COMPANIES
RATE OF RETURN ON INVESTMENT
1921
107 COMPANIES
1922
101 COMPANIES
AVERAGES
1919-22
108 COMPANIES

CHART V

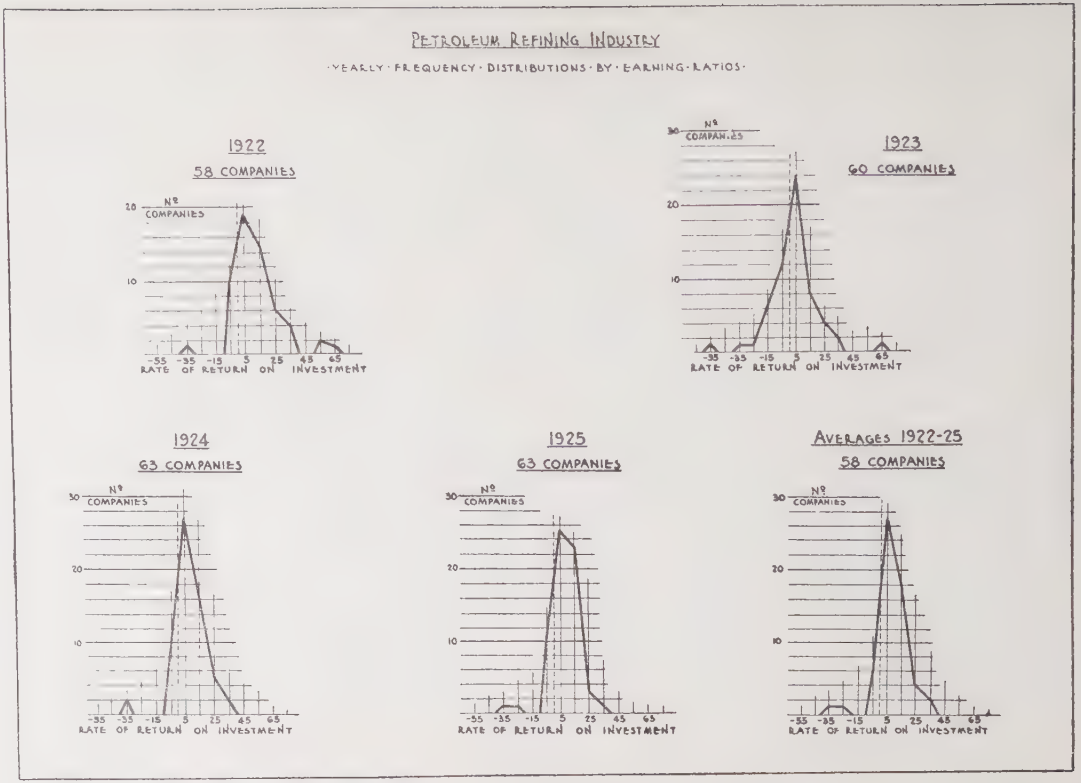
PETROLEUM REFINING INDUSTRY
·YEARLY·FREQUENCY·DISTRIBUTIONS·BY·EARNING·RATIOS·
1922
58 COMPANIES
1923
60 COMPANIES
1924
63 COMPANIES
1925
63 COMPANIES
AVERAGES 1922-25
58 COMPANIES
Nº COMPANIES
RATE OF RETURN ON INVESTMENT

CHART VI

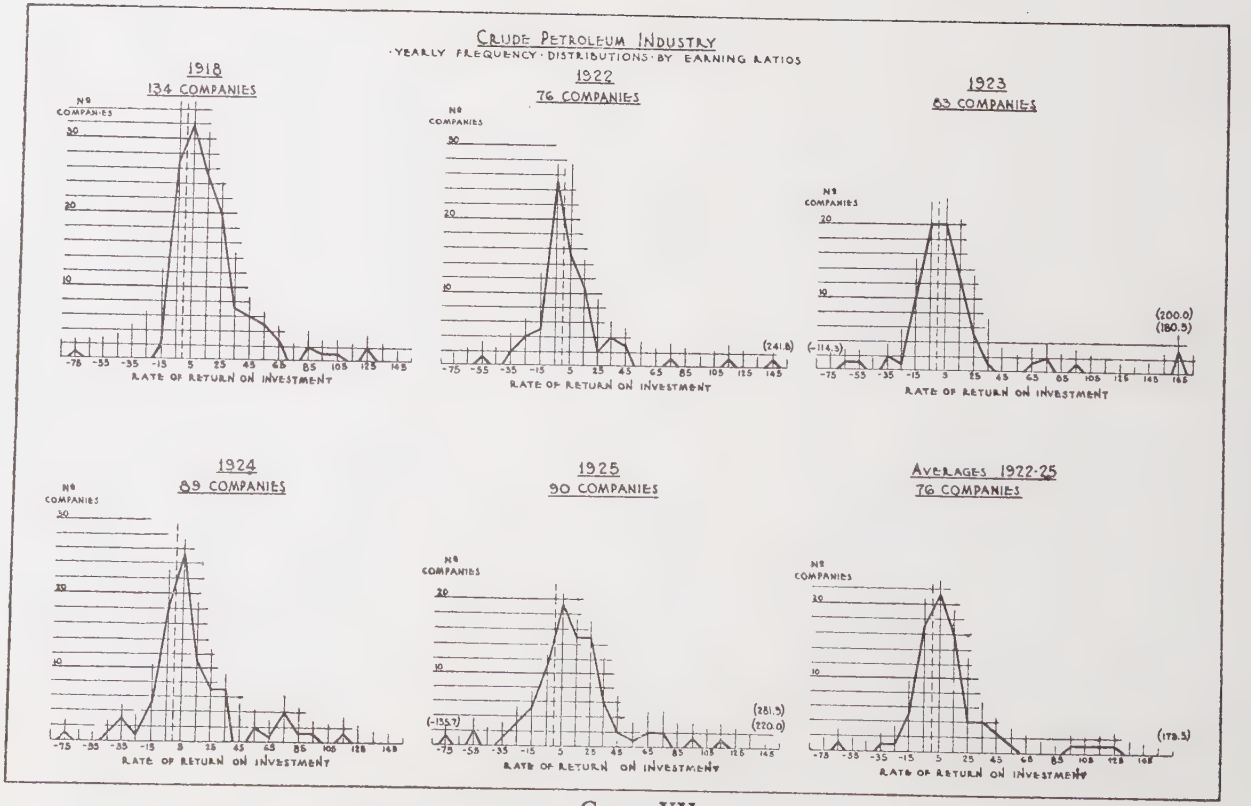
CRUDE PETROLEUM INDUSTRY
YEARLY FREQUENCY DISTRIBUTIONS BY EARNING RATIOS
1918
134 COMPANIES
1922
76 COMPANIES
1923
83 COMPANIES
1924
89 COMPANIES
1925
90 COMPANIES
AVERAGES 1922-25
76 COMPANIES
No COMPANIES
RATE OF RETURN ON INVESTMENT
(241.8)
(200.0)
(180.5)
(-114.3)
(-135.7)
(281.5)
(220.0)
(178.5)

CHART VII

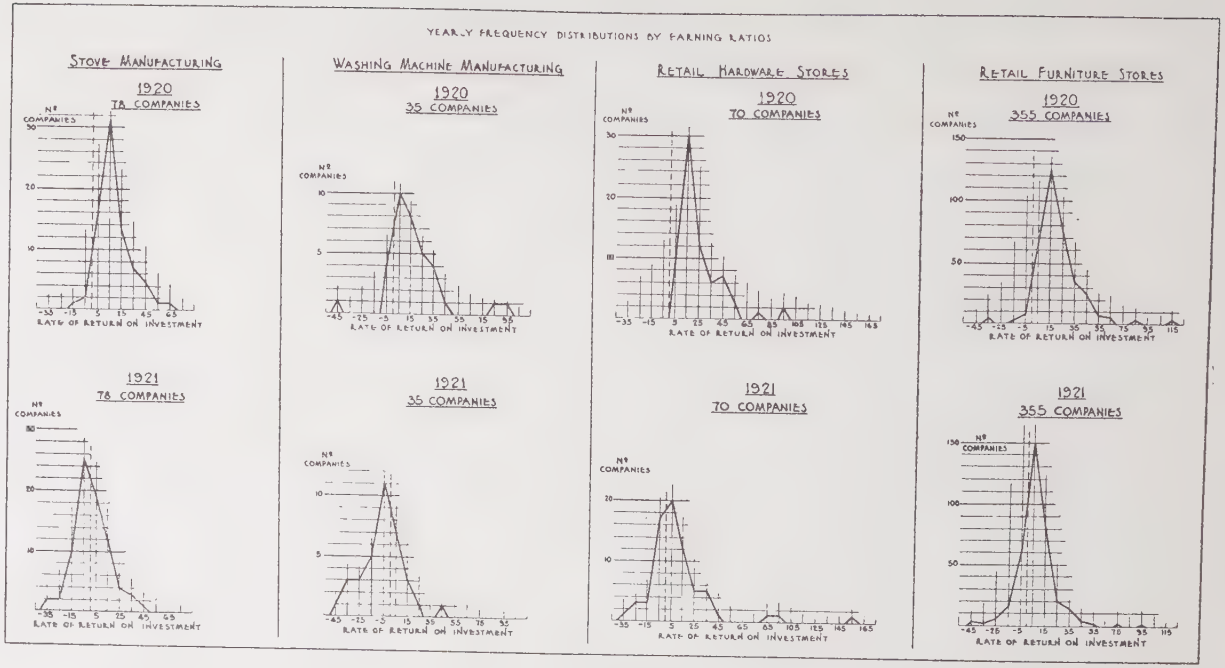
YEARLY FREQUENCY DISTRIBUTIONS BY EARNING RATIOS
STOVE MANUFACTURING
1920
78 COMPANIES
1921
78 COMPANIES
WASHING MACHINE MANUFACTURING
1920
35 COMPANIES
1921
35 COMPANIES
RETAIL HARDWARE STORES
1920
70 COMPANIES
1921
70 COMPANIES
RETAIL FURNITURE STORES
1920
355 COMPANIES
1921
355 COMPANIES
Nº COMPANIES
RATE OF RETURN ON INVESTMENT

Chart VIII

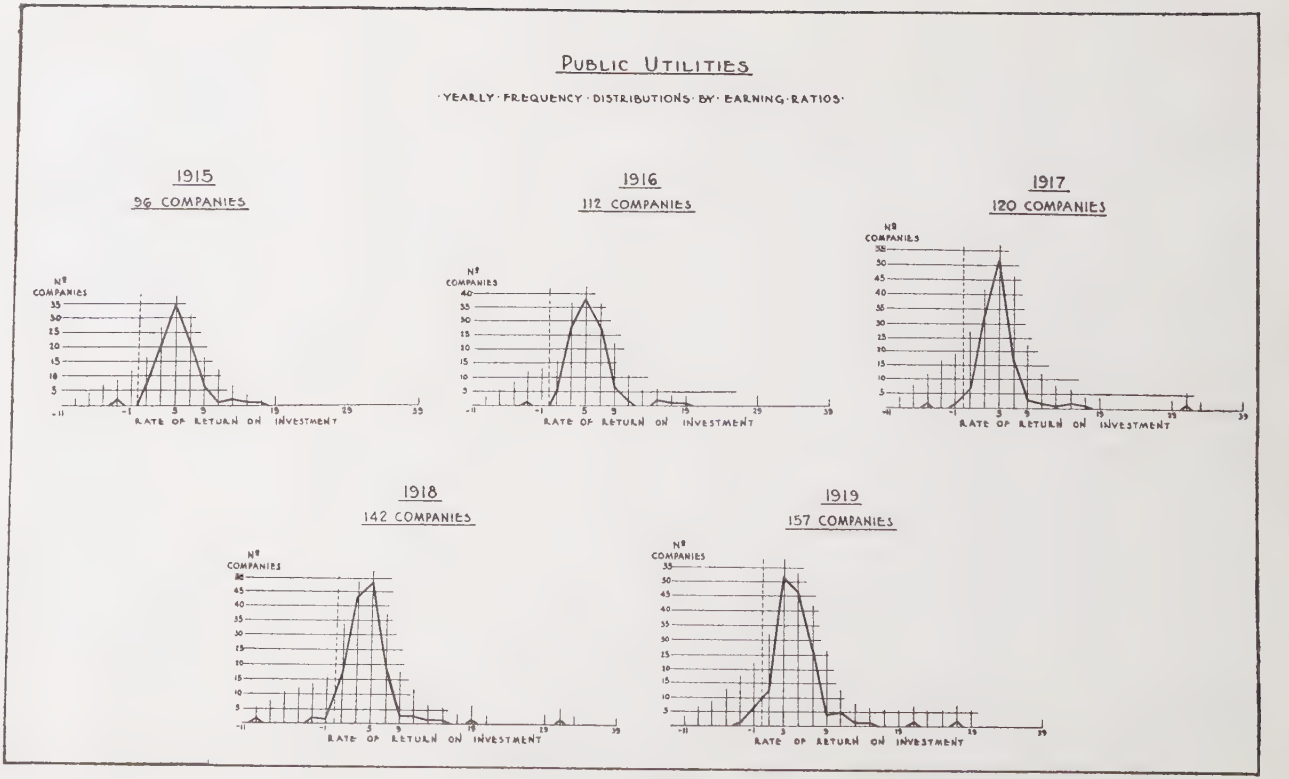
PUBLIC UTILITIES
YEARLY FREQUENCY DISTRIBUTIONS BY EARNING RATIOS
1915
96 COMPANIES
1916
112 COMPANIES
1917
120 COMPANIES
1918
142 COMPANIES
1919
157 COMPANIES
Nº COMPANIES
RATE OF RETURN ON INVESTMENT

CHART IX

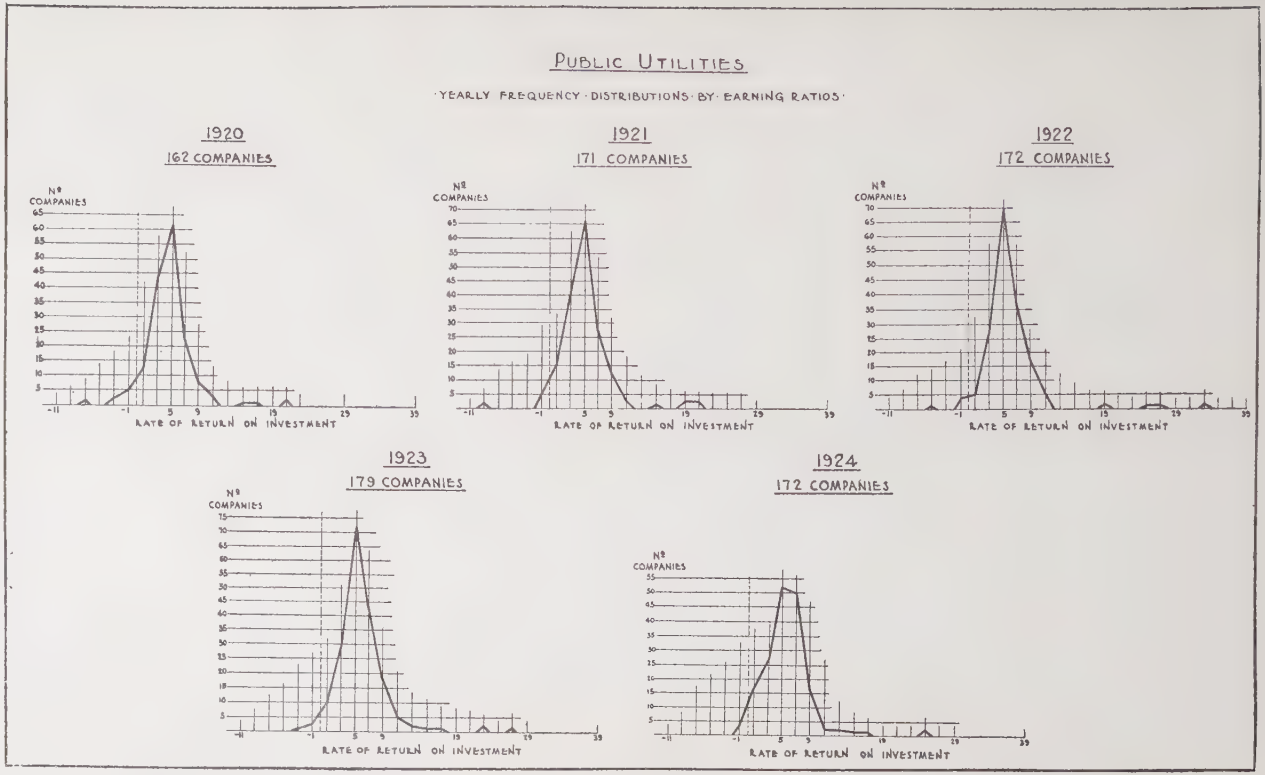

CHART IX (*Continued*)

In comparing measures of skewness, the specific ratio of earnings to investment is not important, since we are not comparing earnings among industries. The important point is whether the earnings for the individual concerns in the industry are on a comparable basis. While this fact cannot be ascertained positively, since the reporting agencies could make few corrections in the figures presented by the individual concerns, every possible method of computing the ratios in the same way from the basic figures supplied was attempted. The comparison of the ratios of earnings for different concerns in the same industry is possible, therefore, if we assume no great discrepancy in the recording of asset and earning accounts and compute skewness on this assumption. Where the material is available, the distributions by earnings ratios can be studied in two ways: first, by examining the distributions of numbers of concerns by earnings ratios, and, second, by examining the distributions of percentages of total assets by earnings ratios.

Skewness

Evidence from Federal Trade Commission and Public Utility Distributions

In Appendix B, Table VII, the various measures of skewness, $M - Md$, β_1, and χ have been recorded for all of the distributions contained in Samples 1 and 2. For our present purpose the $M - Md$ measure is the one used since it is this measure that determines the sign of the other measures. In order to make the measure more strictly comparable, and at the same time to reduce the size of the numbers, this measure has been divided by the standard deviation (σ), and thus constitutes a coefficient of skewness. Table 1 shows in frequency distribution form the coefficients of skewness derived from the 53 distributions in these two samples, and we see very clearly the preponderance of positive skewness, the most prevalent degree of skewness being as high as 10 to 19 per cent of the standard deviation and the next ranking class being from 20 to 29 per cent of the standard deviation. If this

tendency to rather high positive skewness can be further substantiated, it is evident that an arithmetic average of individual concerns' earnings ratios is non-representative, since the median often differs from the mean by an amount ranging from 10 to 29 per cent of the standard deviation.

Of the 43 measures of skewness derived from the distributions in Sample 1 and the ten derived from the distributions

TABLE 1

NUMBER OF DISTRIBUTIONS BY AMOUNT OF SKEWNESS
(*Federal Trade Commission and Public Utility Data*)

Coefficient of Skewness $\frac{M-Md}{\sigma}$	Number of Distributions		
	Federal Trade Commission Data (Sample 1)	Public Utility Data (Sample 2)	Total (Samples 1 and 2)
(−.19)–(−.10)	1		1
(−.09)–(.00)	6		6
.00 – .09	4	5	9
.10 – .19	15	5	20
.20 – .29	12		12
.30 – .39	4		4
.40 – .49	1		1
Total distributions	43	10	53

in Sample 2, we secured 46 distributions showing positive and seven showing negative skewness. All of the seven distributions showing negative skewness are in Sample 1. Of these distributions, four are in the Petroleum Refining Industry, two in the Wheat Flour Milling Industry, and one in the Washing Machine Manufacturing Industry. It is also important to point out that the two in the Wheat Milling Industry appear in the years 1920 and 1921. The negative skewness for the Washing Machine Manufacturing Industry, in addition to being derived from a distribution of only thirty-

five concerns, is likewise for the year 1921. Furthermore, the largest negative skew for the Petroleum Refining Industry appears in the year 1924, which is generally considered a depression year. The distributions for the years 1923 and 1925, in this industry, show negative skewness, but the degree of skewness is very small. Nevertheless, it is worth while to bear in mind the fact that negative skewness is associated with three industries in Samples 1 and 2, so that we may later examine these industries to see if there are reasons why this difference in the characteristic of skewness might be expected.

Evidence from Distributions in the Source Book of Industrial Profits

The 53 distributions discussed above give some basis for generalizing with regard to the character of the skewness of distributions of number of individual concerns by earnings ratios. The frequency distributions in Sample 3 allow us to calculate 158 additional measures of skewness. The lower ends of these distributions are open, so that the means cannot be calculated accurately. This being the case, a measure of skewness not involving the mean was necessary, and Bowley's measure was selected, since it was possible in all but two cases to compute the medians and quartiles.[1] This measure does not involve extreme items, since it takes into consideration only the middle fifty per cent of the items. A preponderance of positive skewness under these conditions will be even more emphatic, and will give added weight to the first findings. Table 2 summarizes the coefficients of skewness derived from these distributions.

Once more we note the preponderance of positive skewness since only 15 of the 158 distributions show negative skewness. Furthermore, six of these nine distributions show a negative skewness of very slight magnitude. It is instructive to note the major industrial groups which show the negative meas-

[1] See Table V, in Appendix B, for the industry and years for which lower quartiles could not be computed.

ures and the years in which such measures appear. The distributions for the years 1919 to 1923, which are based on the percentage of income to capitalization, show negative skewness in the following instances: Major Group 1 (food), for the year 1921; Major Group 3 (leather), for the year 1920;

TABLE 2

NUMBER OF DISTRIBUTIONS BY AMOUNT OF SKEWNESS*

(*Source Book of Industrial Profits Data*)

Coefficient of Skewness $\frac{q_2-q_1}{q_2+q_1}$†	Number of Distributions	
	Percentage of Total Income to Total Capitalization, 1919–1923.‡	Percentage of Total Profits to Total Capital, 1924–1928‡
(−.29)–(−.20)	3	2
(−.19)–(−.10)	3	1
(−.09)–(.00)	0	6
.00 − .09	17	25
.10 − .19	21	28
.20 − .29	16	13
.30 − .39	11	2
.40 − .49	4	3
.50 − .59	3	
Total distributions	78	80

* The individual measures of skewness for each distribution are to be found in Table V, Appendix B.

† For an explanation of this measure, see the text, p. 58.

‡ For the differences between the distributions for the years 1919–23 and 1924–28, see the text, pp. 65, 66, 82, and 122.

Major Group 4 (rubber), for the year 1922; Major Group 9 (stone and clay), for the year 1921; Major Group 14 (retail and wholesale trade), for the year 1922; and Major Group 16 (banking), for the year 1922. The three largest negative measures of skewness are found in the three major groups last mentioned.

The distributions for the years 1924 to 1928, which are based on the percentage of total profits to total capital, show

negative skewness as follows: Major Group 4 (rubber), for the years 1925 to 1928, inclusive, gives all of the three large measures of negative skewness; Major Group 3 (leather), for the years 1924 and 1927; Major Group 11 (scientific instruments), for the year 1924; Major Group 14 (retail and wholesale trade), for the year 1927; and Major Group 16 (banking), for the year 1925. Of the total 158 measures of skewness, only three show zero skewness when the coefficient is carried to two places.

From this analysis, we see that Major Group 4 (rubber) accounts for five of the 15 negative measures of skewness. An inspection of the distributions for this group, as presented in the *Source Book of Industrial Profits*,[2] shows that this group contains only 26 concerns which do not form a very smooth distribution. The analysis of these data seems to indicate rather clearly, therefore, that, with a few exceptions, the skewness of earnings ratio distributions is positive in sign.

Evidence from Distributions of Percentages of Total Assets by Earnings Ratios

The question now arises whether we would secure similar results if we considered distributions of percentages of total assets by earnings ratios rather than numbers of corporations by earnings ratios. Evidence on this point is derived from Samples 2 and 4. Table 3 shows the size of the absolute skewness for the ten yearly distributions (1915 to 1924) for the Public Utility Industry (Sample 2), and the three yearly distributions (1922–1924) for the eleven major industrial divisions in Sample 4.

In general, then, a fairly significant body of evidence shows a preponderance of positive skewness for distributions by earnings ratios, whether those distributions be by number of companies or by percentages of total assets. Before attempting to interpret the significance of this finding, we must examine certain mechanical reasons which might conceivably

[2] For specific references to table and page in the *Source Book*, consult footnotes to Table V, in Appendix B.

account for the skewness. Three possible reasons that suggest themselves immediately are (1) that we are dealing with ratios, (2) that we are dealing with concerns differing in size, and (3) that our data do not include the dying concerns but merely the surviving ones.[3]

TABLE 3

NUMBER OF DISTRIBUTIONS OF TOTAL ASSETS BY AMOUNT OF SKEWNESS*
(*Public Utility and National Industrial Conference Board Data*)

Measure of Skewness $M - Md$	Number of Distributions	
	Public Utility Data (Sample 2)	National Industrial Conference Board Data (Sample 4)
(−.99)–(.00)		2
.00– .99	10	8
1.00– 1.99		13
2.00– 2.99		5
3.00– 3.99		4
4.00– 4.99		1
Total distributions	10	33

* See Tables IV and VI, in Appendix B, for the specific measures for the 43 different distributions.

Skewness and a Characteristic of Ratios

Since we are dealing with ratios, the largest loss that a concern can suffer is 100 per cent, while the greatest gain has no finite limit. This consideration might seem to indicate that the scale of rates should be put in logarithmic form in order to equalize the chances of getting deviations above and below zero earnings. While this possibility is present and may account for some of the skewness, there seems to be little reason for believing that it accounts for much of it.

If distributions of amounts of net income and not ratios of net income to total investment are studied, it will still be

[3] For a previous reference to this last reason, see p. 85.

true that the distributions are positively skewed. This skewness, therefore, is not at all dependent upon the use of ratios, and when the ratios show positive skewness it is a characteristic which is not purely mechanical but is descriptive of the nature of the universe itself and not merely the form in which the data are studied. Of course the size of the absolute net earnings will be closely connected with the size of the concerns, and it is for this reason that we compare ratios rather than absolute amounts.

Skewness and Correlation between Earning Rates and Size of Concern

This second possible explanation of the persistent positive skewness seems very reasonable. Perhaps it is the very small concerns which make the high earning rates, so that the skewness is merely the result of the fact that a very small percentage of assets make high earnings, although a larger percentage of the number of concerns makes these high earnings. Under these conditions the skewness could hardly be said to be representative of the industry as a whole since it is only the small concerns which bring about the skewness. Eliminating a small percentage of assets from consideration, we might secure no skewness at all, or the skewness might even be negative. We have disposed of this possible criticism in part by noting that distributions of numbers of concerns by earnings ratios show positive skewness even when the measure of skewness does not consider the extreme items. Furthermore, distributions of percentages of total assets by earnings ratios show positive skewness. What we need to know, however, if our evidence is to be direct, is whether high earnings ratios are correlated positively with large or small concerns.

This question is difficult to answer, for, to be perfectly sure that any correlation that we compute is meaningful, we must be certain that the financial structure of large and small concerns is not such as to bring about an overcapitalization of the large concerns and thus to indicate lack of correlation

between size of concerns and size of earnings ratio when such is really not the case.

The literature on this subject is not extensive and several attempts to deal with it may be reviewed here. Professor Ralph C. Epstein has computed coefficients of rank correlation between size of firm and size of earnings ratio in the automobile industry for the years 1919 to 1927, inclusive. The number of concerns was only sixteen, but those concerns represented 99 per cent of the capital in the industry in 1919, and produced 95 per cent of the total output of passenger automobiles. As a result of his correlation calculations, Professor Epstein secured the coefficients reproduced in Table 4.

TABLE 4

COEFFICIENTS OF RANK CORRELATION FOR SIZE OF CAPITAL AND RATE OF EARNINGS OF AUTOMOBILE COMPANIES—1919 TO 1927*

Year	Coefficient	Year	Coefficient
1919	.06	1924	.39
1920	−.89	1925	.13
1921	−.99	1926	.40
1922	.02	1927	.51
1923	.34		

* Source: "Profits and Size of Firm in the Automobile Industry," Ralph C. Epstein, *American Economic Review*, December 1931, Table 2, p. 641.

He notes, quite properly, that these coefficients are partly spurious, because they result from correlating a ratio with an amount which is the denominator of the ratio. On the other hand, he says that if we examine the ranking of concerns by capital and by earnings ratios, when arranged for the ten-year period, we see that there seems to be little positive relationship. The coefficients of correlation do seem to indicate, however, that if any positive correlation exists between size and earnings ratios, it varies inversely with the business cycle. In point of fact, the correlation seems to become negative, or very low positive, for depression years. To explain the absence of positive correlation between size and earning rates, Professor Epstein offers the following comments:

> Doubtless so little correlation between *size* and *earning power* here exists because the march of technical progress, as well as changes in fashion, takes place in the automobile industry rapidly and continuously. The rate of such changes and the manner in which their relative emphasis occurs—whether in mechanical designs or in the matter of style—have varied throughout the industry's history, but it has always been possible for the alert though relatively small producer to compete vigorously with the giant firm. The case would be different were both firms selling the same article; that is, marketing a semi-staple product. But automobiles have never been standardized as between different makes of cars; both mechanical design and appearance vary from one make to another. Thus no exact competitive market price, in the orthodox economic sense, is ever established—no price at which the different producers must all sell or leave the market. In a situation where each producer possesses, in a sense, a monopoly of his particular article, the ordinarily accepted advantages of size (enlarged buying power, lower factory overhead costs per unit of product) do not count so much as is commonly assumed. At least they are not decisive. Within relatively broad limits, a producer may set his own price, *and obtain it*, provided that his product incorporates some new feature or combination of features (mechanical, artistic, or both) which appeals to the public.[4]

Mr. H. B. Summers has considered this problem in greater detail.[5] He calculated earning rates for 1130 American and Canadian companies from their statements published in Poor's *Manual* or Moody's *Manual of Industrials*. The selection of companies represented all of the important industries and covered a period of years from 1910 to 1929, inclusive. Not all companies could be treated in every year, so that the average number of years for each company was a little less than 13, and gave a total of 14,195 "company-year" cases, with a reasonably even distribution from year to year in each

[4] Ralph C. Epstein, "Profits and Size of Firm in the Automobile Industry," *American Economic Review*, December 1931, p. 645.

[5] "A Comparison of the Rates of Earnings of Large-Scale and Small-Scale Industries," *Quarterly Journal of Economics*, May, 1932, pp. 465–479.

industry. The concerns were then grouped into seven size-classes for each year included in the study and into nine major industrial groups. The general results are summarized by Mr. Summers as follows:[6]

(1) Taking into account all companies studied, the highest average rate of earnings for the twenty-year period is found in the smallest size-group. (The size-groups were: under 2 million, 2 to 5 million, 5 to 10 million, 10 to 25 million, 25 to 50 million, 50 to 100 million, and over 100 million.) The earnings in this smallest size-group were two per cent higher than in any other group.

(2) For the nine industrial classifications, highest average rates of earnings were found in the smallest size-group (investment below 2 million dollars) for five of the nine classifications. These five were chemicals, automobiles, petroleum, iron and steel, and miscellaneous. In two industrial fields, machinery and textiles, highest average earning rates over the twenty-year period were found in the third lowest size-group (investment between 5 million dollars and 10 million dollars). The remaining two fields, hardware and foodstuffs, have highest average earnings for the twenty-year period in the fifth lowest or third highest investment group (25 to 50 million dollars).

(3) In five of the nine industrial classifications, there is apparently a definite relationship between amount of investment and long-time rate of earnings, with average earning rates decreasing as investment is increased. In the iron and steel industry, the decrease is regular except for the sixth size-group, where the rate of earnings is disproportionately high. In the automobile industry, the same decrease in earning rates is apparent, but with irregularities in the second and seventh size-groups. In chemicals, the seventh size-group provides the single break in the general earning trend. In the textile industry, the rate of earnings increases through the first three size-groups, but declines rapidly beginning with the fourth class. The food-producing industrial group shows earning rates declining regularly as investment is increased, except for the

[6] H. B. Summers, *op. cit.*, pp. 465–479. The four points of summary are not in the exact words of Mr. Summers, but merely paraphrase his remarks. The final summary is an exact quotation.

fifth size-class, in which earnings are relatively high. Marked variations from this tendency in earning rates are found only in the hardware industry, where the three size-groups including the companies with the greatest investments show higher average earning rates than is found for any of the smaller investment groups. Even in this industry, however, companies in the two lowest-investment groups show earning rates not far below three of the concerns in the two largest size-classes. In machinery manufacturing, there is apparently no relation between size of investment and earning power, and aside from the exceptionally heavy earnings of companies in the lowest investment class, the same thing seems to be true in the petroleum and miscellaneous industries classifications.

(4) If we draw various dividing lines between "small" and "large" concerns, with only four exceptions small concerns show higher rates of earnings than large ones. If an investment of 25 million dollars is used as the point of division, small companies show higher rates of earnings than the larger ones except in the food and hardware industrial divisions. If the dividing line is drawn at 10 million dollars, small companies have higher rates of return than large ones except for hardware. If 5 million dollars is taken as the point of division, small concerns show greater average earnings in all industries except that of machinery producing. A dividing line fixed at 2 million dollars shows that the smaller companies show higher average earnings in each of the nine industrial divisions.

In summarizing his findings, Mr. Summers says:

In only one of the nine industrial fields included in the study, hardware manufacturing, does there seem to be any appreciable advantage in profit-earning efficiency accruing to concerns with large investments. In a second field, production of machinery, size apparently has little influence on ability to earn high rates of profit. In the seven remaining industrial classifications, whatever advantage in profit-making ability that does exist, lies with the companies with small investments. In five of the nine fields, there is a recognizable tendency toward lower rates of earnings with every increase in investment.

To conclude: With respect to any "positive advantages" accruing to large-scale production, the study offers nothing

> whatever in support of the idea that size in itself brings greater earning power. On the contrary, so far at least as the 1130 companies studied is concerned, it is apparent that the opposite holds true; and with certain exceptions, heavy investment is apparently a disadvantage, rather than an advantage, in securing high rates of earnings.

In considering these data[7] and their effectiveness in answering the question whether high earning rates are correlated with large-size concerns, several critical observations may be made. Professor Epstein's explanation accounting for lack of correlation between size and earning rates cannot be extended to cover all of the industries surveyed by Mr. Summers. The explanation itself seems to imply that such a condition was not to be expected in general, but this more extensive survey suggests that it is the usual and not the unusual condition. Moreover, we might ask some pertinent questions bearing upon the conclusiveness of these findings. First, why was two million dollars selected as the lowest limit of the size-classes, and what proportion of the companies in each industrial division falls below this limit? If a large proportion, then perhaps a subdivision of size-groups under two million dollars would show lower earnings for the small companies than for the large, although after that size is passed earnings do not increase with size. Second, how consistently do the low investment groups show high earnings from year to year? If earnings are more variable for the large concerns from year to year, then the low average earnings for the twenty-year period may be a result of these wide variations, or, on the other hand, small concerns may show large variations in their earnings by securing unusually high earnings when conditions in general are good, so that their average earnings over a long period are high. If such is the case, size would really be important as an aspect of time analysis rather than analysis in space. Third, we may suspect that large-size corporations more often tend to over-

[7] See Table XIV, in Appendix B, for the reproduction of the main tables in Mr. Summers' article.

state the value of their capitalization and so the earnings may not be comparable. Fourth, what type of distribution would result if each size group were given in distribution form of number of companies by earnings ratios? Perhaps positive skewness would be more marked among the small concerns than among the large and thus seriously affect the representativeness of the average earnings for different size groups, but all the size-groups might show some positive skewness. Some evidence on several of these points will be presented in the following analysis.

In an article entitled "A Theory of Profits and Interest," Mr. Louis Kotany attempts to throw light on the question of the relationship between size of concern and size of earn ings ratio.[8] Mr. Kotany is trying to prove that in every industry there is an optimum size, before which average earnings increase and after which average earnings decrease. The interesting aspect of this article, for our purposes, is that Mr. Kotany uses much of the data contained in the reports of the Federal Trade Commission which we used for the basis of some of our distributions of numbers of concerns by earnings ratios. The Commission in no case reports the actual size of each concern, even though it gives earnings ratios for individual concerns. In many of the reports, however, the Commission reports a weighted mean for the industry in each year, and we have calculated unweighted means so that a comparison of these means will throw some light on the relationship between size of concern and size of earnings ratio.[9] In addition, the Commission often presents tables showing the average earnings for different size-groups for several successive years and the number of concerns in each group. In some instances the commission gives a frequency distribution of the number of concerns in each size-group by earnings ratios, and this type of data is, of course, the most instructive of all. Table XIII, in Appendix B, presents the principal

[8] Louis Kotany, "A Theory of Profits and Interest," *Quarterly Journal of Economics*, May, 1922, pp. 413–53.

[9] In some instances the weighted means are computed from a few less concerns than the unweighted means. See footnote† to Table VII, Appendix B.

tables in the reports of the Commission from which other data used in this study were taken. It will be instructive, therefore, to inspect these data by industries to see what light can be thrown upon the original question. Our first analysis may well be in terms of the relationship between the weighted and unweighted means.

If the unweighted mean is larger than the weighted mean, this divergence indicates that more small concerns make large earnings ratios than large concerns. If the opposite relationship holds between these means, then more large concerns make high earnings ratios than small concerns. Table 5 shows the relationship which holds for the data taken from the Federal Trade Commission reports.

On the whole, Table 5 shows twenty-three instances, out of thirty-nine analyzed, in which small concerns must have predominated among the large earners, leaving sixteen instances in which the opposite condition is true. Examining Table 5 by industries, we see that for the industries in which the years analyzed are wartime years, different conditions exist. In Shoe Manufacturing, small concerns seem favored, but the differences between weighted and unweighted means is small. In the Tanning Industry, small concerns are favored in two out of the five years analyzed, leaving the large concerns in ascendancy. The great difference between the two means in the year 1919 is really due to the fact that it was tanners of kid leather who made the large earning rates (see Table XIII, in Appendix B, and explanation which follows on page 152). The Steel Industry seems to show a definite negative correlation between size of concern and size of earnings ratio, as does also the Southern Pine Lumber Industry.

For the industries in other than war years, we also find diverse relationships. In the Refining of Petroleum, high earnings ratios and large-size concerns seem to go together. In Crude Petroleum just the opposite is true. In Wheat Milling large concerns are correlated with large earnings ratios and, furthermore, under conditions opposite to those we should have expected from the data on the Automobile In-

TABLE 5

RELATIONSHIP OF WEIGHTED AND UNWEIGHTED MEANS*

(*Federal Trade Commission Data*)

Industry	Year	Number of Concerns	Differences Between Weighted Mean (Mw) and Unweighted Mean (M) $M > Mw(+)$ $M < Mw(-)$
Shoe Manufacturing	1914	238	+.19
	1915	237	+.33
	1916	238	+1.36
	1917	238	−1.28
	1919	341	+.10
Tanning	1914	52	−1.00
	1915	53	−.20
	1916	52	−1.50
	1917	53	+1.50
	1919	56	+19.10
Steel	1915	78	+2.5
	1916	78	+23.1
	1917	78	+19.6
	1918	78	+12.4
	Av. 1915–18	78	+14.0
Petroleum Refining	1922	58	+2.5
	1923	60	−2.0
	1924	63	−2.1
	1925	63	−3.3
Crude Petroleum	1918	134	−6.4
	1922	76	+3.7
	1923	83	+4.9
	1924	89	+2.3
	1925	90	+4.1
Wheat Flour Milling	1919	101	+2.6
	1920	105	−3.5
	1921	107	−4.3
	1922	101	−1.6
	Av. 1919–22	108	−1.8

* For the individual weighted and unweighted means, consult Table VII in Appendix B.

TABLE 5 (*Continued*)

Industry	Year	Number of Concerns	Differences Between Weighted Mean (Mw) and Unweighted Mean (M) $M>Mw(+)$ $M<Mw(-)$
Southern Pine Lumber	1917	156	+2.7
	1918	144	+.5
Stove Manufacturing	1920	78	+2.6
	1921	78	+.9
Washing Machine Manufacturing	1920	35	−7.7
	1921	35	−5.4
Retail Furniture Stores	1920	335	−.5
	1921	355	−1.6
Retail Hardware Stores	1920	70	+6.9
	1921	70	+8.9

dustry. The coefficients of correlation computed by Professor Epstein seemed to show the smallest positive correlation, or largest negative correlation, between size of concern and size of earnings ratio in the depression years. Wheat Flour Milling appears to show that the large concerns are better off than the small ones in years of depression. Stove Manufacturing seems to indicate that small concerns make higher earning rates, but again this difference decreases with depression. On the other hand, Washing Machine Manufacturing and Retail Furniture Stores indicate that large concerns predominate in high earning power, and this in depression years as well as good years. Retail Hardware Stores indicate high rates for the small concerns. On the whole, then, these data seem to agree fairly well with the conclusion in Mr. Summers' article, but little light has been thrown, by this type of analysis, on the questions raised by his article. On the whole, these data are most important in indicating the degree by which weighted and unweighted means may differ.

TABLE 6

RANK (HIGH TO LOW) OF SIZE GROUPS BY AVERAGE EARNING RATES*

(*Federal Trade Commission Data*)

Industry	Year	Size-Groups: Low to High						
		I	II	III	IV	V	VI	VII
Shoe Manufacturing	1914	5	1	2	3	4		
	1915	4	1	3	2	4		
	1916	1	5	2	3	4		
	1917	1	4	3	5	2		
	1918	3	1	5	2	4		
	1919	4	1	2	3	5		
	Av. 1914–19	3.	2.16	2.83	3.	3.83		
Tanning	1914	4	1	3	2			
	1915	4	1	3	2			
	1916	4	3	2	1			
	1917	2	1	3	4			
	1918	2	3	1	4			
	1919	1	3	2	4			
	Av. 1914–19	3.16	2.	2.33	3.16			
Steel	1915	1	5	2	3	6	4	7
	1916	1	2	3	4	5	6	7
	1917	7	1	2	3	4	6	5
	1918	1	2	3	5	4	6	7
	Av. 1915–18	2.5	2.5	2.5	3.75	4.75	5.5	6.33
Petroleum Refining	1922	5	1	2	4	3		
	1923	5	1	4	3	2		
	1924	5	1	2	4	3		
	Av. 1922–24	5.	1.	2.66	3.66	2.66		
Crude Petroleum	1922	4	2	1	3			
	1923	2	3	1	4			
	1924	2	4	1	3			
	1925	4	2	1	3			
	Av. 1922–25	3.	2.7	1.	3.25			

* See Table XIII, in Appendix B, for the original tables from which this table was derived.

TABLE 6 (*Continued*)

Industry	Year	Size-Groups: Low to High						
		I	II	III	IV	V	VI	VII
Wheat Flour Milling	1919	1	4	2	3	5		
	1920	5	4	1	3	2		
	1921	5	2	4	3	1		
	1922	4	3	2	5	1		
	Av. 1919–22	4.	3.25	2.25	3.25	2.25		
Southern Pine Lumber	1917	1	4	3	2	5	6	7
	1918	6	4	3	2	1	5	7
	Av. 1917–18	3.5	4.	3.	2.	3.	5.5	7.
Retail Furniture Stores	1920	3	2	4	1			
	1921	3	4	2	1			
	Av. 1920–21	3.	3.	3.	1.			

We shall analyze, therefore, the average earning rates by size-groups for these different industries. The data for this analysis, as has been indicated previously, are presented in Appendix B, Table XIII.

To facilitate the analysis of these tables, we shall first consider the relationship between the ranking of the different size-groups from low to high and the average earning rates for each group when ranked from high to low. Table 6 presents the material in this form.

The meaning of Table 6 can be made clear by an illustration. For instance, for the Shoe Manufacturing Industry in 1914 we have indicated that the second lowest size-group had the highest earning rate, the third lowest size-group the next highest, and finally the lowest size-group the lowest earning rate. The average at the bottom of the yearly rankings of each industry is obtained by adding the figures for the ranks in that column and dividing by the number of years. These average figures indicate the average ranking for all the years. If the entries in the table are interpreted in this way

for each industry in each year, several points related to our original query stand out clearly. First, the highest size-group very seldom makes the highest earning rate. Of the 31 instances in the table the highest size-group makes the highest earning rate only five times. The exceptions to the general rule appear (1) for Retail Furniture Stores, where the largest stores made the higher mean earning rate in each of the two years reported, and (2) for Wheat Flour Milling, where the larger mills had the highest earning rate in two out of four years and the next to the highest in a third year. Second, as a rule one of the groups between the lowest and highest in size seems to show the highest earning rate. It is true that the lowest size-group shows the highest earning rate eight out of 31 times, but the next to lowest size-group shows the highest earning rates 12 times out of 31. Furthermore, an inspection of the average rankings of mean earning rates by size-groups, shows that one of the groups between the highest and lowest in size ranks highest in earning power for five of nine industries, that these "middle" size-groups are tied for highest earning rate in three industries, and that they are exceeded in earning rate ranking in only one industry. Third, the position of the different size-groups, in terms of highness and lowness of average earning rates, seems to vary from year to year, even within the same industry. Fourth, on the whole, the higher earning rates seem to be associated more closely with small size than with large size, although this generalization does not hold true for all industries, or for the same industry in different years.

As a result of this analysis, the writer feels that if any generalization can be drawn, the safest one would be that size and earnings ratios are not correlated highly, either positively or negatively. If this is true, then our measures of skewness are significant, although in some one year they may be less significant than in other years because in some years small concerns may have large earnings ratios. Probably the most illuminating example, for our present purpose, of all those presented in Appendix B, Table XIII, is the one for

Retail Furniture Stores. In this instance we have 355 concerns and the distributions of these concerns by earnings ratios for four different investment classes. It was this industry which showed a rather high positive correlation between the size of the concerns and the size of the earnings ratios, when the weighted and unweighted means were compared, and when the average rates by size-groups were considered. An analysis of the distributions shows that, in general, the ranges of the distributions of individual concerns' earnings ratios within any investment group are about the same. Strictly speaking, this is not absolutely true, since among the smaller concerns there seem to be more making really low earnings rates and more making really high earnings rates, but the modal groups are very similar. We can compute the skewness for these distributions by earnings rates for each size class if we use the quartile measure of skewness and discover whether the skewness by size-classes differs from the skewness without reference to size-class. Without reference to size-class skewness is positive; for the size-class under $100,000 skewness is positive in 1920 and negative in 1921; for the size-class $100,000 to $300,000 skewness is positive in both years; for the size-class $300,000 to $500,000 we find negative skewness in both years, and for the largest size-class we find positive skewness in both years. Positive skewness seems to predominate, therefore, and furthermore the largest concerns give the distributions with the largest skewness. This relationship cannot be taken as representative, however, because, as was noted above, this industry is one in which high earning rates are definitely correlated with large size.

To complete our citation of evidence on this point, attention may be called to Table VI, in Appendix B, which shows the median and quartile earning rates for the major industrial groups, as analyzed by the National Industrial Conference Board.[10] From these data, it was not possible to compute unweighted means to compare with the weighted means which were listed in the report. It was possible, however, to

[10] See Table VI, Appendix B, for the specific reference.

compute medians from distributions of numbers of concerns by earnings ratios, and to compare them with the medians as computed by the National Industrial Conference Board for distributions of percentages of total assets by earnings ratios. An examination of this table will indicate the preponderance of higher values for medians computed from distributions of numbers of concerns over the medians computed from distributions of percentages of total assets. Only two major groups present exceptions to this generalization. The Leather Group gives medians from the distributions of numbers of concerns by earnings ratios which are lower in all three years than the medians from the distributions of percentages of total assets by earnings ratios. In the Retail Trade Group the medians from both types of distributions are equal in 1923 and provide a positive exception in 1924. If relationships of this sort are general, they would indicate a tendency for negative correlation to exist between earning rates and size of concerns. This interpretation is supported equally well by a comparison of quartiles, since, with only the same exceptions, the quartiles from the distributions of numbers of concerns are larger than the quartiles from the distributions of percentages of total assets, thus indicating that the earnings ratios below which 25, 50, and 75 per cent of the companies fall are higher than the earnings ratios below which 25, 50, and 75 per cent of the total assets fall, so that the smaller companies must predominate among the high earners.

The National Industrial Conference Board also gives distributions of average assets per corporation by earnings ratios for each industrial division and for each year.[11] The following illustration for the Industrial Division, entitled Food, is an example of how these data can be arranged and correlated by the method of rank correlation. Table 7 presents the coefficients of correlation which were obtained for all the Groups, and shows the preponderance of small positive or negative correlation. These coefficients agree well with our

[11] National Industrial Conference Board, *op. cit.*, pp. 228–229.

Illustration: Food Division—1922

Profit Ratio on Total Assets	Number Corporations	Average Assets per Corporation*	Rank of Profit Ratio	Rank of Average Assets per Corporation
Up to −10.0	5	$6454	1	4
(−9.9)-(−5.0)	7	9193	2	7
(−4.9)− 0.0	5	7029	3	5
0.0 − 4.9	69	7402	4	6
5.0 − 9.9	82	15753	5	8
10.0 − 14.9	61	4953	6	2
15.0 − 19.9	57	5153	7	3
20.0 and up	95	3407	8	1

* In thousands of dollars.

analysis by medians and quartiles for the two types of distributions. That analysis indicated that positive correlation between size of concern and size of earnings ratio was restricted to the Leather Group for all three years and the Retail Trade Group in the year 1924. These two industries show the highest positive coefficients of correlation.

TABLE 7

COEFFICIENTS OF RANK CORRELATION BETWEEN EARNINGS RATIOS AND AVERAGE ASSETS PER CORPORATION

(*National Industrial Conference Board Data*)

Industrial Division	Years		
	1922	1923	1924
Food	−.57	.26	.17
Textiles	.17	.00	−.74
Leather	−.24	.45	.64
Lumber	.03	−.14	.17
Paper and Pulp	−.82	−.58	−.94
Printing and Publishing	.29	.14	.03
Chemicals	−.77	−.40	.05
Stone and Clay	.15	−.20	.07
Metal	−.52	−.55	−.02
Wholesale Trade	−.46	−.21	−.89
Retail Trade	−.07	−.31	.71

Reconsidering the material analyzed thus far with reference to the relationship between size of concern and size of earnings ratios, we are struck by the fact that the material presented by Mr. Summers and by the National Industrial Conference Board seems to indicate a higher negative correlation between size of concern and size of earnings ratio than is indicated by the material provided in the reports of the Federal Trade Commission.

From the material presented in the *Source Book of Industrial Profits*,[12] only one table is available which throws light on the problem under discussion. This table is rather suggestive, however, for it gives distributions of numbers of companies by earnings ratios for each of several size-groups in the years 1924 and 1928. The only difficulty is that the material is not presented for each Major Industrial Group, but for a combination of the first eleven groups and separately for Major Groups 12 to 14 inclusive, as may be seen by examining Table XVI in Appendix B. On the whole, however, this table seems to indicate that the distributions within different size-groups are not materially different from the distributions for all size-groups combined. At the bottom of each of the distributions by size-groups in Appendix B, Table XVI, we have recorded the medians, quartiles, and skewness measures. Major Groups 1 to 11 give positive skewness for each distribution by size-groups in both years. Major Groups 12 to 14 show two instances in 1924 of negative skewness, one for the fifth size-group (5 to 24 million dollars) and one for the sixth size-group (25 to 50 million dollars). These facts indicate rather clearly that positive skewness is representative for all sizes of concerns. Furthermore, there seems to be no consistent evidence in this table which would indicate that the skewness of distributions of small concerns is larger in amount than the skewness of distributions of large concerns. Nevertheless, it should be noted that the median earnings for the smallest size-group rank highest for the Major Groups 1 to 11 in both years.

[12] See Table XVI in Appendix B, for the specific reference.

One further bit of evidence may be cited in concluding our discussion on this point. The material on Public Utilities made available the actual investment size of each of the concerns in each of the ten years.[13] When these concerns are ranked by order of earnings ratio from high to low and by size of investment from high to low and the paired rankings are correlated by the method of rank correlation, coefficients as presented in Table 8 are secured.

TABLE 8

CORRELATION BETWEEN RANK OF CONCERNS BY EARNINGS RATIO AND RANK BY SIZE OF TOTAL ASSETS

(*Public Utility Data*)

Year	Number of Concerns	Coefficients of Correlation
1915	96	−.13
1916	112	−.07
1917	120	−.04
1918	141	.03
1919	156	−.04
1920	161	−.03
1921	170	.04
1922	171	.12
1923	178	.18
1924	170	.16

Certain elements of spuriousness enter into the calculation of such a coefficient, but the spuriousness would make for larger negative and not larger positive correlation, so that for our purpose the present coefficients serve to indicate the lack of any large negative or positive correlation.

Another method of studying the effect of size upon skewness for the Public Utility Industry would be to compute the mean and median earnings for different size-groups. This has been done and the results are recorded in Table III, in Appendix B. An inspection of this table shows that irrespective of size the earnings ratios are generally skewed in a positive

[13] See previous reference on page 64.

direction. The smallest size-class exhibits no instance of negative skewness for the entire ten-year period. The next to the smallest size-group shows negative skewness in one year (1921); the third size-group shows negative skewness in the years 1916, 1921, and 1924, while the largest size-group shows negative skewness in the years 1917 and 1918.

The size-group with the highest average earning rate varies from year to year, and the ranking of the groups by earning rates differs depending upon whether we select means or medians as the average. On the whole, then, positive skewness seems to be a legitimate characteristic of our earnings ratio distributions.

Skewness and the Absence of Growth and Decline

The third reason which we cited as a possible mechanical explanation of positive skewness was based upon a certain limitation in our data. The distributions we have analyzed contain the same concerns from year to year. If the dying concerns had been included perhaps the skewness would be negative. On the other hand, the inclusion of the new concerns might have increased the positive skewness. There seems to be no way by which this possibility can be checked, since the data on the number of concerns that fail each year are very poor and would have little meaning for the inquiry unless the losses of these concerns were also known. If we restrict our conclusions, so that they refer to the continuous history of a group of concerns that live during the period analyzed, our measures of skewness are applicable and have significance.

Skewness of Distributions by Earnings Ratios: Summary and Interpretation

The material analyzed above shows a preponderance of positive skewness and this characteristic does not seem to be explainable in terms of the mere mechanical aspects of our distributions. If this conclusion is valid, then the skewness is characteristic of the causal universe from which differences

in earnings rates for individual concerns in the same industry arise. If almost all of our distributions did not show this same type of skewness, we should have had to analyze skewness by industries; but since nearly all show the same type of skewness, this characteristic need not be related to any particular industry. The general conclusion must be, then, that in almost every case, and without regard to the industry, some few concerns in each year will have earnings ratios which are high as compared with the modal earning rate for the industry. Furthermore, as a result of this analysis, we know that a mean earning rate, whether calculated from a distribution of percentages of total assets by earnings ratios or from a distribution of numbers of concerns by earnings ratios, is not representative of the industry's earning rates. Just how high the earnings ratios of these few concerns really are can be discussed only after we know something about the usual position of the mode or median and the dispersion of the earning rates around such a central value. If the median value is generally very low and the dispersion large, then the existence of positive skewness indicates rather clearly that profits in an industry really mean profits for a few concerns only. This must mean that, in most instances, the forces making for profits relate not to an industry but to a few individual concerns which happen to be favored by the force of circumstances. Just what the nature of these possible favorable conditions may be must await further analysis.

Central Tendency

Purpose of Central Tendency Analysis

We mentioned above that our interpretation of the findings with regard to skewness would be improved if we knew something about the position of the central tendency. On the other hand, we noted in an earlier section that since the same basis for computing earning rates was not always employed in the original derivation of each of our samples of data, or in some instances even for different industries within the sample, we could not compare central tendencies for

very many of our distributions. While this is true for any comparison which aims to interpret small differences, it need not prevent us from ascertaining roughly just what earning rate is most often realized for all of our distributions by earning rates. All we aim to discover is whether, without regard to time, there is some representative earning rate which prevails. Since we have median values for every one of our distributions and the modal value is so difficult to compute accurately for distributions with high skewness,[14] the median as the measure of central tendency must serve our present needs.

Evidence and Analysis of Median Position

Table 9 presents, in grouped form, the limits within which the various median values from different distributions are located.

For the Federal Trade Commission data, the nine instances in which the median was higher than 20 per cent are taken from the wartime years. The highest median earning rate was that for the steel industry in 1917. Of the six instances of median earning rates within the limits of 15 to 20 per cent, three are for wartime years in the Shoe Manufacturing, Tanning, and Steel industries. The other three instances were found distributed over three industries in the year 1920. One was Stove Manufacturing, one Retail Furniture Stores, and one Retail Hardware Stores. The two negative median earning rates appeared in distributions for the year 1921, one being in Wheat Flour Milling and the other in Washing Machine Manufacturing.

The median earning rates derived from the distributions in the *Source Book of Industrial Profits* show 19 distributions with median earning rates greater than 20 per cent. The first point to be noted is that the earning rates in these distributions represent the percentage of "total net income" (net earnings after payment of all business expenses and fixed charges including interest on bonded debt but before federal

[14] See the analysis on pages 153–161.

income taxes) to "capitalization" (sum of preferred stock, common stock, and surplus and undivided profits). The distributions for the years 1924 to 1928, inclusive, are based upon the percentages of "total profit" (net earnings plus estimated interest on bonded debt) to "total capital" (capitali-

TABLE 9

NUMBER OF DISTRIBUTIONS BY MEDIAN EARNING RATES*

(*All Four Samples*)

Median Values	Number of Distributions						
	Federal Trade Commission Data (Sample 1)	Public Utility Data (Sample 2)		Source Book of Industrial Profits Data (Sample 3)		National Industrial Conference Board Data (Sample 4)	
		Distributions of Number of Companies	Distributions of Percentages of Total Assets	Distributions 1919–1923	Distributions 1924–1928	Distributions of Number of Companies	Distributions of Percentages of Total Assets
(−9.99)-(−5.00)	1						
(−4.99)- .00	1						
0.00- 4.99	5	6	5	2			5
5.00- 9.99	12	4	5	10	16	8	18
10.00- 14.99	9			25	56	20	10
15.00- 19.99	6			24	8	5	
20.00- 24.99	3			9			
25.00- 29.99	2			5			
30.00- 34.99	2			2			
35.00- 39.99	1			3			
40.00- 44.99							
45.00- 49.99	1						
Total distributions	43	10	10	80	80	33	33

* See Tables IV, V, VI, and VII in Appendix B, for the individual measures.

zation plus bonded debt).[15] As a result of the two different methods of stating earning rates, the median earning rates for the 1919 to 1923 distributions are apt to be higher than the median earning rates for the 1924 to 1928 distributions. If, as is likely, the percentage of net income to capitalization is higher than the estimated interest on bonded debt (five

[16] See footnotes 24 and 25 on page 66.

per cent), then the net income plus five per cent of the bonded debt (total profit) as a percentage ratio of capitalization plus bonded debt (total capital) will be smaller than the former ratio.[16] The second point to be noted is the fact that the distributions reporting net income as a percentage of capitalization include two years in the post-war prosperity era, viz., the years 1919 and 1920. Of the 19 distributions showing median earning rates of 20 per cent or higher, all but two are for the years 1919 and 1920. The two exceptions are for the major industrial divisions listed as Printing and Stone and Clay, the former for the year 1922 and the latter for 1923. Both of these exceptions fall just above the 20 per cent mark; the median earning rate for Printing in 1922 was 21.4 per cent and the median earning rate for the Stone and Clay division in 1923 was 20.8 per cent.

Taking into consideration these two facts, we can see that the most prevalent median earning rate for all samples except Public Utilities falls within the interval from 5 to 14.99 per cent. We may obtain a better idea of the most prevalent median earning rate by dividing the two classes (5 to 9.99 and 10 to 14.99) into four classes and noting where the modal group lies. When we do so, we get the following results:

Median Value	Sample 1	Sample 2	Sample 3		Sample 4	
			Distributions 1919–1923	Distributions 1924–1928	Distributions of Number of Companies	Distributions of Percentages of Total Assets
5.00– 7.49	4		5		3	7
7.50– 9.99	8		5	16	5	11
10.00–12.49	5		11	35	14	9
12.50–14.99	4		14	21	6	1

[16] A company with a "capitalization" of $1000 and a bonded debt of $1000 might have a "net income" of $100. As a result the net income would be 10 per cent of the capitalization. The net income plus 5 per cent of bonded debt ($150) would constitute "total profit," and would only be 7.5 per cent of "total capital."

Except under very unusual conditions, the median earning rates for an industry, Public Utilities excepted, are seen to range between zero and 15 per cent, with the most common median between 10 and 12 per cent. Since, in most instances, these earning rates were based on net earnings before the payment of interest or federal taxes, these elements should be considered before indicating the profitableness of an industry as a whole. We must realize, further, that the modal rate would be even lower than the median. Furthermore, the distributions in Sample 4, when based upon percentages of total assets rather than number of companies, have even lower median rates. This indicates that the earning rate below which 50 per cent of the assets fall is generally lower than the earning rate below which 50 per cent of the companies fall. This does not seem to be true for the Public Utility Industry, since the median earning rates from distributions by number of concerns for this industry are generally lower than those from distributions by percentages of total assets.

In the case of the Public Utilities, we find that approximately five per cent is the most prevalent median rate for the ten distributions which we have analyzed. To be specific these median rates range between 4.31 and 5.45 per cent when taken from distributions by numbers of concerns, and tween 4.40 and 6.04 per cent when taken from distributions by percentages of total assets. The narrower range for the median values in the Public Utility Industry and the lower values are not surprising in the light of the characteristics of the industry and the use of total assets as the base for computing the earnings ratios. The outstanding fact about the Public Utility distributions is, as we shall see later, that, with the exception of the position of the median and one other item to be mentioned later, they are similar to the distributions from the other samples.

These findings with regard to the central earnings ratio for the different industries must be considered in the light of the information introduced earlier with reference to the method of calculating the investment figures for the different sam-

ples.[17] Since Samples 2 and 4 use total assets as the investment base we would expect earnings ratios from these two samples to be lower than those from the other two samples. This expectation is definitely realized in the case of public utilities (Sample 2), but not in the case of the National Industrial Conference Board data (Sample 4). Sample 3 shows the expected bias in the distributions for the years 1919 to 1923, inclusive, and 1924 to 1928, inclusive.[18] Sample 1, which includes the eleven industries investigated by the Federal Trade Commission, would be expected to agree with the *Source Book* distributions for the years 1924 to 1928, inclusive, if it were not for the fact that almost all of the years represented by this sample are unusual years. This lack of comparability in these data would be extremely serious if our interest were centered on the absolute values of the central measures. As we have pointed out, however, our interest is in the nature of the causes which bring about the entire distributions of earnings ratios. The central values of these distributions are important merely as a reference point in the characterization of the distributions, and their absolute values are not the principal concern of our study. If, within an industry, the rates of earnings are comparable, then the characteristics of the distributions will be significant and will help us to understand the nature of the causal universe from which the individual earnings ratios arise. This contention is, of course, premised upon the assumption that the investment figures on which the earnings are expressed as percentages are fairly accurate *indexes* of investment, although they are not identical measures of investments.

Because we have taken this attitude no attempt will be made to take the most usual central value (10 to 12 per cent), subtract from it an estimated normal interest charge plus Federal taxes, allow for the difference between the mode and the median, and then conclude that industries do or do not normally make profits which are large or small. It might seem

[17] See pp. 60–69 and 78–85.
[18] See pp. 82, 83.

as if this procedure would be legitimate for a given body of data such as the material from the *Source Book*, since the method of computing the ratios for a large part of these data is identical. We must remember, however, that even this material is subject to certain objections, since it does not include the failing or new concerns in each year, so that our average earnings ratio is not an average from a complete sample and has definite meaning only in terms of the actual inclusions in the sample.

The restrictions just enumerated do not prevent us from developing the relationships between the central values and the variability of the individual earnings ratios around this value. Thus far we have discovered that the individual earnings ratios are not distributed symmetrically. This information is extremely important for any use to which an average might be put. Furthermore, we are now in a position to develop the extent to which variation around the central value prevails by studying the dispersion and concentration of the earnings ratios. In addition, we can discover whether the concerns show a tendency to maintain the same position from year to year as regards earning power or whether a regressive tendency exists which moves them back to the central value. Finally, we can offer some evidence with regard to the permanence or lack of permanence of the most representative earnings ratio for different industries when considered in relationship to the most usual rate for all industries combined.

Only one body of data is extensive enough to allow us to make comparisons for different industrial groups in the same year. Sample 3 provides sixteen distributions for each of the years from 1919 to 1928, inclusive. Table 10 presents the median values for each of these industrial groups in each year with certain statistical measures descriptive of the medians in each year taken as a group. Though 16 items do not constitute a very large distribution, certain rather significant conclusions seem to be tentatively deducible from this material.

It is remarkable that, even when these median values are

grouped without respect to the year in which they were realized, a significant concentration develops, so that the distribution is fairly smooth. This fact would seem to indicate that the central values do not differ materially under "normal" conditions, even when the distributions from which they are drawn have significantly different characteristics, for all of the extreme median industrial earnings ratios are accounted for in terms of unusual years. In the light of these suggestions, it is advisable to consider these median values in a given year as a frequency distribution and to compare their central tendencies and dispersion with what we have found out about similar aspects of our distributions by earnings ratios for different industries. In the next chapter, we shall note whether the major industrial groups show median earning rates which have the same ranking in successive years and certain other aspects of temporal change. At the bottom of Table 10 we have presented certain statistical measures which describe the median values in each of the years 1919 to 1928, inclusive.

These measures indicate that the sixteen median values are distributed in each year in a fairly symmetrical manner and that the degree of dispersion, except in the years 1919 and 1920, is very small. The statistical measures derived from the yearly industrial median values seem to differ in some respect for the years 1919 to 1923 as contrasted with the years 1924 to 1928. We have already noted that the earnings ratios from which the median values were drawn in these two periods were computed differently, so that the median values for the distributions in the years 1919 to 1923 have an upward bias, and that the years 1919 and 1920 were unusually prosperous years, with 1921 a year of depression. These facts are clearly evidenced by the means of the median values and the medians of these values. Only one of these mean or median values in the period 1919 to 1923 is as low as the mean and median values in the period 1924 to 1928, and this value occurs in the year 1921. Even among the distributions in the first five years, however, 1919 and 1920

stand out as unusual. This divergence is attested by the size of the standard deviations as well as by the size of the central values. The skewness and dispersion measures in general are higher for the first five distributions than for the last five

TABLE 10

MEDIAN EARNING RATES FOR EACH MAJOR INDUSTRIAL GROUP IN THE YEARS 1919 TO 1928, WITH STATISTICAL MEASURES RELATING TO THE DISTRIBUTIONS OF THESE MEDIANS*

(*Source Book of Industrial Profits Data*)

Major Group	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928
1. Food	25.2	12.2	14.1	18.7	14.4	15.1	12.8	12.9	12.3	11.8
2. Textiles	36.4	12.2	12.2	18.6	16.2	13.3	11.6	9.2	11.6	8.0
3. Leather	34.3	8.0	6.7	15.6	11.3	10.6	10.7	10.5	12.6	10.3
4. Rubber	26.0	7.6	3.7	15.7	12.5	11.5	16.9	11.1	11.7	7.5
5. Lumber	24.2	22.8	6.7	18.0	18.1	14.3	13.7	11.8	9.1	9.9
6. Paper and Pulp	24.5	37.4	5.4	14.9	13.1	11.4	11.5	11.0	11.5	9.5
7. Printing	24.0	32.5	18.1	21.4	17.6	16.6	16.4	15.5	12.7	13.8
8. Chemicals	24.0	15.9	7.7	18.0	14.0	12.9	13.7	14.0	12.6	13.1
9. Stone and Clay	17.7	18.2	11.7	16.2	20.8	15.7	15.8	14.7	11.0	11.2
10. Metal	26.1	18.8	4.5	13.4	16.7	11.6	14.4	14.2	10.9	12.4
11. Scientific Inst., etc.	26.7	17.8	10.4	16.4	17.3	15.4	13.5	13.7	12.2	10.9
12. Retail Trade	36.3	17.1	10.9	16.8	16.4	12.8	13.6	12.9	11.2	10.8
13. Wholesale Trade	24.8	15.9	5.4	12.1	12.9	10.1	9.9	8.9	8.8	8.3
14. Retail and Wholesale	27.8	20.5	8.4	14.9	14.5	12.2	11.2	10.4	10.2	8.9
15. Extractive	12.7	17.2	7.3	12.0	12.3	9.1	11.1	11.6	10.2	10.0
16. Banking	13.1	12.7	9.7	13.8	10.6	9.5	10.3	9.9	9.9	9.8
Mean of Medians	25.2	17.9	8.9	16.0	14.9	12.6	12.9	12.0	11.1	10.4
Median of Medians	25.0	17.2	8.0	15.9	14.1	12.5	13.1	11.7	11.3	10.1
Skewness of Medians ($M-Md$)	.2	.7	.9	.1	.8	.1	−.2	.3	−.2	.3
Standard Deviation of Medians	6.6	7.7	3.8	2.7	2.8	2.4	2.3	2.1	1.6	1.7

* See Table V, in Appendix B, for other references to these data.

and the skewness measures are consistently positive. The last five distributions of median values give evidence of being fairly symmetrical since the degree of skewness is small and negative almost as often as it is positive.

This evidence with regard to central values for earning rates by industries seems to support the general idea that a representative average earning rate for the different industries falls close to 10 or 12 per cent and that such earning rates are not deviated from by large amounts by the different industries except in unusual years, when a higher representative average earning for all the industries together is accompanied by a more than proportionate increase in dispersion. In the next chapter, this same material will be analyzed with reference to time. Two questions to be raised there are: Do industries keep their rankings with regard to earning power in successive years? Are their median earning rates correlated with any other aspect of their earnings ratio distributions?

Summary and Interpretation of Evidence on Central Tendency

Although the several bodies of evidence, when considered irrespective of years, seem to show a tendency for the median earning rate in different industries to approximate 10 to 12 per cent of the investments, we refused to use these figures as absolute values. Our reasons for this decision are grounded primarily in the differences that exist between the methods of measuring investments and earnings in the different samples. A second reason for the failure of the figures to be interpretable as absolute measures of earning power, even for the distributions which are comparable as regards the methods used in computing the ratios, is based upon the incompleteness of the samples because only the concerns which lived through the entire period are included while the dying and new-born concerns are excluded.

This decision does not, however, materially affect our use of the central values, because we are primarily concerned with these values as reference points for studying the entire distribution of earnings ratios in the different industries from year to year. The conclusions we felt justified in making can be summarized, therefore, as follows: (1) the distributions of company earnings ratios for the different industries seem

to tend towards similar medians, (2) the median rates are probably lower for distributions of percentages of total assets than they are for distributions of numbers of concerns, and (3) in unusual years when the average of the median rates for all industries is high there is a more than proportionate increase in the disparity between the rates for the different industries.

Dispersion

Relationship of Dispersion to Skewness and Central Tendency

We have remarked above that a complete interpretation of skewness must await the analysis of central tendency and dispersion. The position of a representative central tendency for our distributions has now been discussed, and we have seen that the usual values of such a measure for our distributions range between 10 and 12 per cent. As a result of this analysis and the preceding investigation of skewness, we know that although 50 per cent of the concerns in our distributions commonly have earnings which are above or below 10 or 12 per cent, the extreme deviations of individual company earnings ratios from the central earnings ratio are more pronounced in the direction of high earnings ratios than of low or negative earnings ratios. In order to develop further our understanding of the distributions of rates of earnings, we must know the extent of variation about the central rate. The following discussion relates to measures of dispersion, or variance, and provides this necessary information.

Dispersion as Measured by the Standard Deviation

The standard deviation (σ) is a common measure of variance around the mean, and this measure can be used to indicate the extent of dispersion for the distributions in Samples 1 and 2. As the other samples do not allow the computation of the standard deviation, another measure of dispersion will have to be used when we examine the dispersion of the earning rates for the distributions included in those samples. Table 11 presents the standard deviation measures for the distributions in the first two samples.

If the distributions of numbers of concerns by earnings ratios were normal, then σ would have a more definite meaning, since 67 per cent of the items would fall within the limits of $\pm\sigma$. Since the distributions are not normal, this definite interpretation is not possible. The size of σ does indicate, however, the high amount of variance among the earnings of individual concerns in the same industry.

Comparison of the absolute size of the standard deviation is permissible in these instances, from a purely mechanical

TABLE 11

NUMBER OF DISTRIBUTIONS BY AMOUNTS OF DISPERSION*

(*Federal Trade Commission and Public Utility Data*)

Size of σ in Percentages	Number of Distributions	
	Sample 1	Sample 2
0.00– 9.99	4	10
10.00–19.99	25	
20.00–29.99	7	
30.00–39.99	5	
40.00–49.99	1	
50.00–59.99	1	
Total distributions	43	10

* For the values of σ for the individual distributions, see Table VII, in Appendix B.

point of view, because all of the standard deviations are expressed in the same units. If we had reason, however, to believe that the size of the variance was subject to the same influences as those affecting the mean, we should reduce our standard deviations to coefficient form by dividing by the mean. We shall show later that no such hypothesis is warranted, and, in addition, since our distributions contain both positive and negative values, the mean may become zero, so that the use of such a coefficient might raise certain theoretical questions. Furthermore, the computation of this coefficient is not necessary at this point because the extent

of variation is shown clearly by the absolute value of the standard deviation.

Dispersion as Measured by the Inter-Quartile Range

To obtain a more definite idea of the dispersion of the items in the central part of the distributions, we may use the inter-quartile range, since it tells the limits within which

TABLE 12

NUMBER OF DISTRIBUTIONS BY SIZE OF INTER-QUARTILE RANGE*

(*All Four Samples*)

Inter-Quartile Range in Percentages ($Q_3 - Q_1$)	Federal Trade Commission Data (Sample 1)	Public Utility Data (Sample 2)		Source Book of Industrial Profits Data (Sample 3)		National Industrial Conference Board Data (Sample 4)	
		Distributions of Numbers of Companies	Distributions of Percentages of Total Assets	Distributions 1919–1923	Distributions 1924–1928	Distributions of Numbers of Companies	Distributions of Percentages of Total Assets
0.00– 9.99	4	10	10	5	28	5	20
10.00–19.99	26			50	52	28	12
20.00–29.99	9			20			1
30.00–39.99	1			3			
40.00–49.99	1						
50.00–59.99	1						
60.00–69.99	1						
Total distributions	43	10	10	78	80	33	33

* For the specific measure for each distribution consult Tables IV, V, VI, and VII, in Appendix B.

the middle 50 per cent of the items fall. Furthermore, this measure allows us to include all our samples and thus to increase the evidence on this point. Table 12 presents these measures in a summarized form.

An examination of Table 12 shows an extreme variance of earning rates for 13 distributions in Sample 1. The distributions from which these inter-quartile ranges were derived reveal the following facts: seven of the 13 inter-quartile

ranges beyond 19.99 per cent are from distributions in the Shoe Manufacturing, Tanning, and Steel industries, and these distributions are all for war or early post-war years. The distribution of earning rates in Shoe Manufacturing for the year 1919 has an inter-quartile range of 22.6 per cent. Two distributions for the Tanning Industry, one for the year 1916 and the other for the year 1919, have inter-quartile ranges of 22.58 per cent and 67.9 per cent, respectively. Four of the distributions for the Steel Industry during the war show the following inter-quartile ranges: 44.8 per cent for 1916, 52.3 per cent for 1917, 31.5 per cent for 1918, and 28.0 per cent for the distribution by average earnings for the years 1915 to 1918, inclusive. The other six distributions with inter-quartile ranges in excess of 19.99 per cent are found in the following industries: four in the production of Crude Petroleum for the years, 1918, 1923, 1924, and 1925, and two in the Washing Machine Manufacturing Industry for the years 1920 and 1921. The size of the inter-quartile range for the Crude Petroleum Producing Industry was 24.6 per cent in 1918, 23.9 per cent in 1923, 22.1 per cent in 1924, and 27.8 per cent in 1925. The inter-quartile ranges for the Washing Machine Manufacturing Industry were 20.8 per cent and 20.0 per cent for the years 1920 and 1921, respectively.

Certain other peculiarities of the data should also be mentioned at this point. The 158 distributions in Sample 3 can best be discussed by separating the 1919 to 1923 distributions from the 1924 to 1928 distributions. The earlier distributions show five cases out of 78 where the inter-quartile range is less than 10 per cent. Four of these distributions are for the Wholesale Trade, and Banking Groups; and the fifth, coming in the year 1923, is for the Rubber Group. The Banking Group contains three of these low dispersion measures, the other two measures for this group being only 10.0 and 10.1 per cent. The dispersion of the distributions for the period 1924 to 1928 shows 28 instances out of 80 in which the inter-quartile range is less than ten per cent. Fourteen

of these small dispersion measures are taken (out of a possible total of fifteen measures) from three major groups, Retail Trade, Wholesale Trade, and Retail and Wholesale Trade, respectively. Five others of these low dispersion measures are taken from the Banking Group, which bring the total accounted for by five major groups to 19 out of 28. This fact seems to indicate that the size of the dispersion is consistently associated with an industry. This point will be investigated further in the next chapter when we study temporal changes and must ask the question, is the ranking of industrial divisions by size of dispersion similar from year to year? The preliminary indications are clearly in favor of such an interpretation. Added support for this interpretation is indicated by the distributions in Sample 4, since the five instances where the inter-quartile range is less than ten per cent are derived from a total of six distributions, three for Retail Trade and three for Wholesale Trade. Of the four instances in Sample 1 below ten per cent, two are from the Southern Pine Lumber Industry in the years 1917 and 1918, and the other two are from the Wheat Milling Industry, one being for the year 1922 and the other for the distribution by average earning rates in the Wheat Milling Industry for the years 1919 to 1922, inclusive.

One other point is worthy of special notice. For Samples 2 and 4 we have inter-quartile ranges derived from distributions by percentages of total assets as well as by numbers of companies. The distributions in Sample 4 show that the concentration of earning rates is greater for distributions based upon assets than it is for distributions based upon numbers of companies. We have already noticed[19] that for Sample 4 the medians for the assets distributions are lower generally than the medians for the numbers of companies distributions, and we now know that in general the dispersion around the medians from the assets distributions is smaller. This is not true for the Public Utility distributions, for in only two years (1918 and 1924) are the inter-quartile

[19] See page 125.

ranges of the assets distributions lower than those for the numbers of companies distributions.[20]

To give a more exact idea of the usual extent of the inter-quartile range, the following groupings have been so constructed as to divide into smaller divisions the class intervals below 19.99 per cent.

Inter-Quartile Range in Percentages (Selected Class Intervals)	Sample 1	Sample 2		Sample 3		Sample 4	
		Distributions of Numbers of Concerns	Distributions of Percentages of Total Assets	Distributions 1919–1923	Distributions 1924–1928	Distributions of Numbers of Concerns	Distributions of Percentages of Total Assets
0.00– 2.49		2					
2.50– 4.99		8	10				1
5.00– 7.49				2	6		3
7.50– 9.99	4			3	22	5	16
10.00–12.49	4			12	24	17	9
12.50–14.99	8			12	24	11	2
15.00–17.49	8			14	3		
17.50–19.99	6			12	1		1

Summary and Interpretation of Dispersion Analysis

We may now summarize our findings regarding dispersion. In general, the extent of variation is probably larger than would have been expected. Our measures of the inter-quartile ranges show that in the middle fifty per cent of the distributions earning rates vary from five to 20 per cent, with the most usual inter-quartile range approximating ten per cent. These measures seem to show, moreover, that the amount of variance differs for different industries, and that the Trade and Banking Divisions have the smallest variance for the middle 50 per cent of their distributions. The extreme amount of variation for 13 distributions in Sample 1 shows that dispersion is materially affected by the existence of large disturbances in economic conditions and by the peculiar conditions of certain industries (e.g., the Crude Petroleum In-

[20] Compare the measures of inter-quartile ranges for the Public Utility Industry, as presented in Tables IV and VII, in Appendix B.

dustry shows a larger amount of dispersion than any other industry during normal times).

As a result of these conditions two other questions must be answered. Will industries or industrial groups, if ranked in any one year by amount of dispersion as measured by the inter-quartile range, keep approximately the same ranking in successive years? Is the standard deviation of these measures for any one year indicative of significant differences or variance in the dispersion of different industrial groups? The regrouping of Table 12 (page 133) indicates that, in contrast with the grouping of median values, the amount of dispersion as measured by the inter-quartile range does not seem to show any high degree of concentration. This fact might be explained in terms of our discovery that certain major industrial groups appear to show different degrees of dispersion. Furthermore, since our data cover several years, there may be enough change in the average degree of dispersion to bring about a distribution by measures of variance which approximates a rectangle, or trapezoid. Tentative answers to these questions can be made if we analyze the inter-quartile ranges for the 16 distributions in Sample 3 by years. We can do this by computing yearly means, medians, and standard deviations for the dispersion values. In addition, we can, in the next chapter, correlate the rankings of these measures between successive years. Table 13 presents the necessary information in the proper form for this procedure.

The statistical measures recorded at the bottom of Table 13 do not indicate any marked degree of change in the average variability of earnings rates for different industries from year to year, since the means of the values of the inter-quartile ranges do not vary by large amounts. The amounts of dispersion (σ) of the 16 inter-quartile ranges in each year are not very large and seem to remain fairly constant from year to year. The same contrast between the distributions for the years 1919 to 1923 and those for 1924 to 1928 is still evident. Since this contrast has already been explained as due in large part to the different methods used to compute the

earnings ratios, it hardly seems worth while to caution the reader again. It is important, however, to point out that, within the period 1919 to 1923 itself, the years 1919 and 1920 are again exceptional and show a higher average amount of dispersion than the other years. In this case, however, 1922

TABLE 13

INTER-QUARTILE RANGES FOR THE SIXTEEN MAJOR INDUSTRIAL GROUPS IN THE YEARS 1919 TO 1928*

(*Source Book of Industrial Profits Data*)

Major Groups	Values in Percentages									
	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928
1. Food	29.0	18.6	14.5	19.1	14.0	12.1	12.6	12.9	12.2	10.9
2. Textiles	27.7	22.4	16.1	18.1	11.2	11.0	11.3	9.5	10.0	10.0
3. Leather	25.6	15.7	14.5	16.6	12.3	7.9	10.1	11.7	9.5	8.8
4. Rubber	20.0	12.4	12.5	15.0	8.8	10.4	9.5	14.0	12.3	12.8
5. Lumber	26.0	26.5	11.9	19.9	13.6	12.3	12.6	12.4	10.4	9.8
6. Paper and Pulp	25.9	33.0		17.8	14.2	11.0	9.6	11.1	10.6	9.0
7. Printing	23.6	30.0	18.2	24.1	15.7	14.1	15.0	14.1	14.1	9.8
8. Chemicals	29.1	21.3	16.7	24.0	16.7	16.9	18.6	14.8	14.9	15.4
9. Stone and Clay	22.8	23.0	14.7	17.0	15.6	13.1	13.4	11.4	10.9	12.6
10. Metal	25.6	18.8		18.2	14.5	12.4	13.1	12.9	11.4	12.5
11. Scientific Inst., etc.	19.9	16.3	13.4	15.1	13.9	12.6	13.2	12.6	12.5	12.8
12. Retail Trade	32.0	17.7	11.2	14.4	11.6	9.9	9.7	9.4	9.7	9.6
13. Wholesale Trade	21.4	21.0	11.3	11.8	8.9	7.5	7.9	7.9	6.2	7.3
14. Retail and Wholesale	23.2	19.8	13.3	11.3	11.9	10.2	9.1	9.2	7.7	8.4
15. Extractive	19.2	26.6	14.0	16.4	15.7	11.3	12.8	13.6	13.6	11.9
16. Banking	10.0	10.1	7.0	9.4	6.9	7.2	6.6	7.5	6.6	6.7
Mean of Inter-Quartile Ranges	23.8	20.8	13.7	18.0	12.5	11.2	11.6	11.6	10.8	10.5
Median of Inter-Quartile Ranges	24.6	19.9	14.2	16.8	13.7	11.1	12.1	12.0	10.7	10.0
Skewness of Inter-Quartile Ranges ($M-Md$)	.8	.8	−.5	1.2	−1.2	.1	−.5	−.4	.1	.5
Standard Deviation of Inter-Quartile Ranges	5.1	5.9	2.5	6.3	4.0	2.6	3.1	2.0	2.4	2.3

* See Table V, Appendix B, for the sources of these data.

also seems unusual. In general, we may say that, with the exception of very unusual years, the average dispersion of distributions of earning rates for different industrial divisions remains fairly constant. The constancy of the average, however, only gives greater emphasis to the fact that there is not the same high degree of clustering of dispersion values that there was of median values. Perhaps this fact

can be accounted for when we study the permanence of the ranking of industries by the size of the dispersion of their earning rates and contrast this with the permanence of an industry's rank in median earnings.

Our information thus far allows us to conclude that different industries seem to differ a little more in the variability of their earning rates than they do in the size of their median earning rates, since the indication is that the same industry tends to show high or low dispersion with greater regularity than it does high or low median earning rates.

Kurtosis

Purpose of Kurtosis Analysis

The next phase of our discussion is the study of the kurtosis of the distributions of earnings ratios. It might be imagined that, since we have discussed dispersion, there is no need to consider peakedness as a special characteristic of the frequency distributions. This is not the case, however, for kurtosis refers to the concentration about the central value in terms of the deviations from that value, since β_2 is defined as the fourth moment about the mean divided by the square of the second moment about the mean. What we want to know is whether the distributions are peaked, and they may be so, even though the standard deviations are large, because the fourth moment may be larger than would be found in a normal curve with the same standard deviation. Kurtosis, as an attribute of frequency distributions, indicates the extent to which certain forces make for a central tendency as contrasted with those forces that bring about extreme variations. For this reason we are interested in this aspect of the problem.

β_2 as a Measure of Kurtosis

In Chapter II we indicated that β_2 is a measure of kurtosis and that when it is larger than 3 the distribution is said to be leptokurtic, or more peaked than the normal curve. The only part of our material which makes possible the computa-

tion of β_2 is Samples 1 and 2. It will be recalled that Sample 1 contains 43 distributions, and Sample 2 ten distributions. Of these 53 distributions, 52 give values of β_2 greater than 3. The one exception is in the Tanning Industry for the year 1919, where the distribution is bi-modal and falls under the U-shaped variety of curves. Since this exception will be discussed in the next section on curve types, we shall, for the present, concentrate our attention upon the 52 distributions that show a concentration greater than that to be found in

TABLE 14

NUMBER OF DISTRIBUTIONS BY SIZE OF β_2 AS A MEASURE OF KURTOSIS*

(*Federal Trade Commission and Public Utility Data*)

Size of β_2	Federal Trade Commission Data (Sample 1)	Public Utility Data (Sample 2)
3– 6.9	25	1
7–10.9	10	3
11–14.9	5	2
15–18.9	1	1
19–22.9	1	2
23–26.9		1
Total distributions	42	10

* For individual values of β_2 consult Table VII, Appendix B.

the normal curve. Table 14 indicates the size of β_2 for these 52 distributions.

Summary and Interpretation of the Leptokurtic Nature of the Distributions

What is the meaning of this general result, which shows that distributions of numbers of concerns by earnings ratios are more peaked than the normal? Our analysis of the logical conditions underlying the normal curve indicated that the central tendency in that curve was the result of a constant cause modified by variable causes. As a result, the variation about the central tendency has definite meaning in terms

of that central tendency. The fact that the concentration for the distributions which we are studying is greater than that to be found in the normal curve must be interpreted in the light of the fact that these distributions, for the most part, show large dispersion and are positively skewed. If this were not true, it might seem that an arithmetic average derived from these distributions would be even more representative than the same sort of average derived from a normal distribution. But since skewness is present, there is a possibility that the central tendency and the variation around it are not associated in the same way in our distributions as in the normal curve. The kurtosis, or concentration, may represent the competitive forces present at any given moment and may be said to be a measure of these "static" forces. On the other hand, the variation about the mean, as indicated by the standard deviation and measures of skewness, may be largely influenced by chance factors present at that time. These chance factors, not being equally balanced and uncorrelated, give the distributions of earnings ratios a positive skewness with high dispersion, but the constant forces still exist and make for a central value around which the concentration is dense in relation to the spread or range of the entire distribution. As a result of this type of variable forces, central tendency, as measured by the mean, is not correctly represented, since the mean is very easily influenced by extreme items. This fact may explain, to some extent, the extreme movements which are generated by time series of mean averages.

To make the illustration more specifically economic, we may say that the size of β_2, or the kurtosis of a distribution, is a measure of the competitive forces which make for uniformity of earnings ratios for all concerns within the industry, but that the variation indicated by the measures of dispersion and skewness represents the play of uncertain chance elements, some of which are correlated and some few of which are apt to be more largely determinate than others. In this way the lack of balance in the distributions can be

accounted for and related to the large kurtosis with some degree of probability. The chance elements present at any moment arise in time and may bring about movements of certain items not at all correlated with the movement generated by the forces of central tendency. Under these conditions, the central tendency is not a function of the variation around it and a mean is not representative as a measure of the central forces. The central tendency may or may not move in time with the variations about it, and this possibility will have to be investigated in the next chapter. If the general interpretation of earnings ratio distributions sketched here can be further substantiated in the final analysis, it will provide an important basis for a theory of profits in space and time. Before we make further investigations, however, it is desirable to find out whether any mechanical reasons exist which would explain the kurtosis of earnings ratio distributions.

Kurtosis of Distributions of Price Relatives and Suggested Interpretations

In Professor Mills' study, *The Behaviour of Prices*, β_2 was found to be consistently larger than three. Professor F. R. Macaulay, in commenting on the size of β_2 in this case, indicated that this was probably due to what he called the "inertia of prices." By this expression he meant to indicate that certain prices show great inertia to change and, as a result, any rise in the average is largely a result of changes in the prices of a few commodities not subject to this inertia. Can this interpretation be applied to earnings ratios? Would it be meaningful to talk about the "inertia of earning rates?" Before attempting to answer these questions, we may consider another way of interpreting the phrase, "the inertia of prices." Suppose that during any process of change there is a tendency for many prices or many earnings ratios to increase by a fixed percentage. To illustrate: if the price level is falling, certain prices may be reduced at given times by a certain arbitrary percentage. If this arbitrary percentage is

fairly similar for many prices, distributions of linked relatives would show a high concentration as a result of this purely mechanical coincidence. With reference to earnings ratios, would this possibility be meaningful?

Value of Suggestion of "Inertia" to Explain the Kurtosis

The suggestion just offered would be more meaningful for our data if we were analyzing distributions of changes in earnings ratios between successive years or from a given base year. Since we are not here concerned with distributions of amounts or percentage changes, the suggestion is really not in point for our present analysis. In each year we have found high kurtosis for the actual earnings ratio distributions and not changes in earnings ratios. In the next chapter we shall analyze distributions based upon changes in earnings ratios between successive years, and for those distributions the suggested explanation will be meaningful. The evidence to be presented will, however, show clearly that the kurtosis of distributions of changes in earnings ratios is not due to the factor of inertia as defined above. A more meaningful explanation of it might be based upon the suspicion that the extreme items in these distributions are heterogeneous elements and do not really belong to the distributions. Since the elimination of these extremes would affect the fourth moment more than the second moment, β_2 might, as a result, become smaller and less than three, since, as previously noted, it is defined as $\frac{\nu_4}{\nu_2^2}$. This possibility will be investigated and analyzed in the next section, dealing with curve types.

For the present, we may conclude that our earnings ratio distributions are characterized legitimately as leptokurtic and our interpretation of this leptokurtosis is not damaged by mechanical reasons accounting for the kurtosis.[21]

[21] Another method of estimating the concentration of earnings ratios that would not involve the fourth moment may have suggested itself to the reader. Since for the normal curve $\frac{\frac{1}{2}(Q_3-Q_1)}{\sigma}=.675$ (approx.), then, if the percentage ratio is less

Curve Type

Possibilities of Curve-Type Analysis

In Chapter II we indicated that, in addition to studying the significant characteristics of frequency distributions, we might go further and use all of the intellectual paraphernalia provided by the Pearsonian curves and criteria in the effort to see whether generalizations could be made more specific. It was suggested that perhaps we could discover not only a general prevailing sign of skewness and type of kurtosis but a specific curve type as well. The question to be raised might well have run something like this: are distributions of numbers of concerns by earnings ratios describable by a Type III curve or some other skew type of curve? We may find that generally Type I, Type IV, or Type VI curves are the prevailing types. Our ability to do this, if it could be done, would give us complete graduations of the number of concerns making different earnings ratios in each year. The type of curve prevailing would also enable us to say something about the nature of the underlying causal universe which prevails if a given curve type persists in time. The possible implications of this sort could not be very specific, however, since, as we noted in an earlier chapter, the only Pearsonian curve which has a definite logical foundation is Type III. If the curve type derived from earnings ratio distributions was of neither the normal nor the Type III variety, then the most we could say would be that it differed from the normal curve or Type III in certain respects. In addition to considering the deviation of the curve types realized from either the normal or Type III, the criterion r, previously described,

than .675, the plus and minus limits of the standard deviation *probably* contain more than 67 per cent of the frequencies; if the ratio is larger than the ideal ratio, then fewer than 67 per cent of the items *probably* fall within the standard deviation limits. A comparison of the standard deviations and inter-quartile ranges recorded in Table VI, Appendix B, will convince the reader that the measure suggested above would also indicate higher concentration than found in the normal curve. In most instances the standard deviation is as large as, or larger than, the inter-quartile range, so that the ratio of one-half the inter-quartile range to σ must be .5 or less. In the other cases, the ratio is always less than .675, with the exception already noted when we considered the size of β_2.

might also be used to provide some interesting and important suggestions.

Since the meaning of the criteria of curve type has been developed already, our problem in the present chapter is to present the curve types derived from the distributions of earnings ratios and to interpret them in terms of what we know about economic reality. To picture clearly the different curve types in relation to the values of the β_1 and β_2 measures, Chart X has been prepared. It illustrates the main Pearsonian curve types.

Attributes of Frequency Distributions and Pearsonian Curve Types

As in Chapter IV we shall be discussing the relationship of certain of the measured characteristics of our distributions in time, so that it is important to note here a definite characteristic that exists for the curve types describing our distributions. All curves of Types III, IV, V, VI, and VII must have values of β_2 which are greater than three. Bell-shaped Type I curves can have values of β_2 between 1.8 and 3, if β_1 is .7 or less, but β_2 must be larger than 3 if β_1 is larger than .7; J-shaped or U-shaped Type I curves can have values of β_2 less than 3 only if β_1 is 1.2 or less. Therefore, all curves having significant skewness, as measured by β_1, must necessarily have values of β_2 greater than 3, and the significance of such values must thus be interpreted with caution. All Type II curves must have values of β_2 less than 3, and, as will be noticed later, we do not secure any Type II curves from the original distributions. When we secure curves with close to zero skewness, but β_2 larger than 3, Type VII, and not Type II or the Gaussian, is approximated. As noted above, if β_2 is greater than 3, the concentration about the measure of central tendency is greater than the concentration of a normal curve with the same standard deviation.

If the standard deviation does not vary with the mean, then perhaps a relationship between β_2 and the mean will not be meaningful in the same sense. On the other hand, what

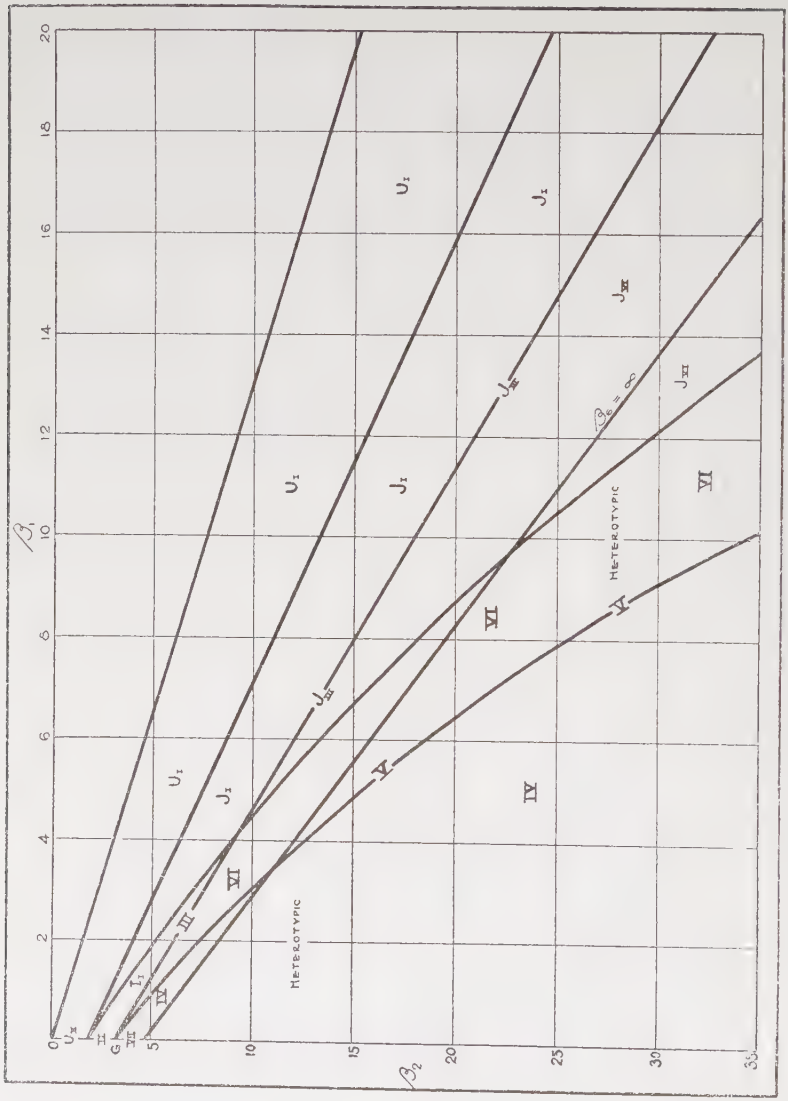

CHART X. FREQUENCY DISTRIBUTION TYPES

meaning can be assigned to the statement, "When β_2 is greater than three, the concentration about the central tendency is greater than it would be in a normal curve with the same standard deviation," if the curve type with a large β_2 is of the J or U variety? β_1 as a measure of skewness under these conditions has a different significance,[22] and it seems to the present writer that β_2, for these cases and for all markedly skew distributions, merely indicates that these curve types are by their nature highly concentrated in relation to their range.

Curve Types Derived

Table 15 presents our findings with regard to curve type as derived from the 43 distributions of the Federal Trade Commission data (Sample 1) and the ten distributions of the Public Utilities data (Sample 2). In specifying curve type we have indicated the main types and possible transition types (see Table VI, Appendix B). The transition types (Types II, III, V, and VII) are merely appraisals indicating that the values of the criteria are roughly equal to the specific values necessary to give the transition type. For instance, for Type III the criterion κ_1 should equal zero. If κ_1 is at all near zero (say .8), we have indicated Type III as a possibility.[23]

[22] For a J curve the skewness (χ) is a function of the distance from the mean to the asymptote while in a U curve the skewness is a function of the distance from the minimum frequency to the mean. This must be true because the distance between the mean and the mode is given by $\chi\sigma$ and the mode for a J curve is the asymptote while for a U curve it is the minimum ordinate.

[23] It might seem that a more accurate method would have been to compute the probable errors of the curve type criteria. For instance, Mills (*Behavior of Prices*, p. 328) indicates that a price relative distribution deviates from the normal type when the skewness and kurtosis measures differ from their values for the normal curve by more than 2.576 times their standard errors, since such a result would occur less than one time out of 100. This procedure would serve to indicate deviations from the normal type, but the other types would involve greater difficulties. Mills uses the standard error formulas which tell him the chances of getting criteria values that differ from their values for the normal curve, *if the universe from which the sample is drawn was normal.* If we use the tables in Pearson's *Tables for Statisticians and Biometricians* to compute the probable errors or standard errors of the curve type criteria, we obtain the chances that, *if the universe sampled is of the type indicated by the criteria of the sample*, another sample would not give different values for these criteria. For all small samples, the values of these probable errors would be large

If we had really expected to discover a single curve type descriptive of earnings ratio distributions, one glance at Table 15 would dispel such an expectation. The Type IV

TABLE 15

NUMBER OF DIFFERENT CURVE TYPES*

(*Federal Trade Commission and Public Utility Data*)

Main Curve Types	Number of Distributions	
	Sample 1	Sample 2
I	16 (4F)† — 5 I_1, of which 5 may be Type III; 10 J_1, of which 3 (3F) may be Type J_{III}; 1 U_1 (1F)	
IV	22 (10H) — of which 8 may be Type VII and 1 Type V but 5 of these fall in the heterotypic area.	6 (4H) — of which 2 may be Type V
VI	5 (1H) — of which 2 may be Type V and 1 Type III	4 — 3 J_{VI}, of which 1 may be a Type V
Total distributions	43	10

* See Table VII, Appendix B, for the curve type for each distribution by industries.

† The numbers and letters in parentheses indicate the number of each curve type which have values of r which are positive and 7 or less, or negative and numerically less than 4. The letter (H) indicates positive measures, and the letter (F) negative measures.

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and would not help us at all in making decisions as to curve type. Furthermore, our data are not really being analyzed as samples, since we are centering our interest on the type of recurring distributions which appear for the same concerns in different years. Under these conditions, the probable errors which could be derived would have little or no significance for our purpose.

curve predominates, but 14 of the 28 distributions falling under this type are really not describable by the Pearsonian system, since the values of the curve type criteria, as indicated by the values of r, are unreliable. For the Federal Trade Commission data, Type I curves are a close second, although here we find all three varieties of Type I represented. Four of these distributions have values of r which are negative and numerically less than 4, so that, according to R. A. Fisher, the curve type indication is not very reliable.[24]

Of the 16 Type I distributions, 12 are derived from industries where the data cover the war or early post-war years. The Shoe Manufacturing Industry gives Type I_1 for the year 1919, and for the average of the years 1914–17, although three of the distributions for those individual years are Type IV's, while the other one is a Type VI. All five distributions for the Steel Industry, four of the six distributions in the Tanning Industry, and the 1917 distribution for Southern Pine Lumber, classify as Type I curves. Of the other four distributions classified as Type I, two appear in the years 1920 and 1921 for the Retail Hardware Stores distributions, while the other two are derived from the distributions for the Crude Petroleum Industry in the year 1922 and the averages of the years 1922–25.

It appears, therefore, that this type does not characterize the industries but the period. This interpretation is indicated by Mills' study of price behavior. He says:[25]

> During times of extreme price disturbance natural distributions, particularly unweighted distributions, tend to deviate above the Type III line, into the area of J-curve of Type I. This is the type of distribution followed by unweighted fixed base relatives in natural form in 1915, 1916, 1917 and 1918, by unweighted link relatives in natural form in 1915, and by weighted link relatives in natural form in 1923.

Of the other industries represented in Sample 1 for other than war years, Type IV is the general characterization by

[24] See previous discussion on page 53, 54.

[25] F. C. Mills, *op. cit.*, p. 327.

industry as well as for all industries together. The two exceptions are the Crude Petroleum Industry and the Retail Hardware Stores.[26]

Summary and Interpretation of Curve-Type Analysis

The only definite generalization that can be drawn from these curve type derivations has already been drawn without the consideration of curve type at all. Distributions of earnings ratios do not closely approximate the normal distribution or Type III, the other logically founded distribution. The values of the criteria never closely approximate the values for the normal curve, and our indication that nine of the 53 distributions might be taken as Type III curves is very liberal, on the basis of the criteria values. Seven of the distributions might be classified as Type V, for which κ_2 should equal one, and eight other distributions might be taken as sufficiently symmetrical to be classified as Type VII curves, although both of these are liberal estimates.

If we had a large number of industries represented over the same period of years, and if the number of years were sufficiently large, it might be possible to see whether or not the distributions approached any one curve type as the stable type. For instance, Type III or Type V might be approached by different industries after periods of disturbance, while during those disturbed periods the curve types might deviate above or below the two more stable types.

Since the data do not provide sufficient material for testing such a generalization, we must be satisfied with more restricted conclusions. Our curve type analysis has shown that, although earnings ratio distributions have the common characteristics of positive skewness and peakedness greater than that of the normal curve, no one type of curve would serve for descriptive purposes, even within a single industry. The distributions are sufficiently different from year to year so that no one curve type can be used.[27]

[26] See Table VII, Appendix B.

[27] The fact that the criteria indicate a given curve type should not be taken as evidence that if this type of curve were fitted to the empirical distribution it would

Evidence as to Stability of Type

In Chapter II, we remarked that, in addition to interpreting frequency curves in terms of their deviation from either the normal curve or Type III, we could study the stability of the distributions as indicated by the criterion r, which indicates the power at which the moments become infinite.[28] The 53 distributions which we have just discussed in terms of curve type may now be examined more specifically in terms of stability. An examination of Table VII, in Appendix B, shows that of the 37 distributions having values of r which are positive, 15 have values of r which are seven or less. This fact indicates that no Pearsonian curve will represent the data since the measures derived from these distributions are unreliable because of the size of their probable error. The fact that about 40 per cent of the distributions are not stable, in the sense in which stability has been defined, is a significant indication of the divergence of these distributions from the stable types represented by the normal curve and Type III. In addition, it is important to note that, as 27 of the 37 distributions have values of r less than ten and 34 have values of r less than 20, the almost universal tendency of these distributions is to fall outside the boundaries of the Pearsonian system of curves.

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necessarily give a "good fit." The goodness of fit could be determined only after the application of the theoretical curve to the data. In this study we are not concerned with the problem of exact graduation, so that we do not have to consider whether the Pearsonian curves give graduations of the data which are as good as, or better than, those that could be obtained from other systems of curves. We are using the Pearsonian system because it gives the best indications with regard to the deviations of the distributions from the normal or Type III variety of curves. If the indications were such that the use of graduations seemed promising, we should have to consider this problem. Two interesting examples of this problem recently came to the attention of the writer. In 1927, Dr. H. M. Lufkin presented to the graduate faculty of the University of Pennsylvania a doctoral dissertation entitled *The Best Fitting Frequency Function for Urban's Lifted Weight Results*. This thesis was printed in the *American Journal of Psychology*, Vol. XL, No. 1. The general conclusion was that Gram-Charlier Curves give, on the whole, slightly better fits to these data than the Pearsonian Curves. Another very interesting example is a study entitled *Life Characteristics of Physical Property*, by R. Winfrey and E. B. Kurtz, Bulletin 103, Iowa Engineering Experimental Station, Iowa State College.

[28] See pp. 52–57.

Furthermore, of the 16 curve types which have negative values of r, four are numerically less than 4. This fact indicates, according to Fisher, that the method of moments does not serve to graduate or indicate the curve type very efficiently. While small values of r do not mean that the distributions cannot be graduated, they do indicate, according to the Pearsonian system, that these types are far removed from the stable types, such as the normal curve and Type III.

Interpretation of Stability of Type

It is extremely difficult to evaluate these findings in terms which will throw some light on the nature of the causal universe from which the earnings of these concerns are derived. It is fairly evident, however, that the causal universe is not an example of an even play of balanced forces or even of forces making for a regular asymmetry. Sporadic elements must predominate, so that a second sample drawn from the same universe cannot be relied upon to give results similar to those derived from a first sample. If these conditions are true of distributions of other types of economic units, then the apparently strange behavior of certain time series is completely understandable in terms of the nature of their underlying causal universe. More work must be done in this field and every attempt made to refine the data and exclude any heterogeneous elements that may now be present. Until we have ascertained with greater precision the underlying factors which bring about the sporadic elements, we must proceed with great care in the use of time series.

An Example of Heterogeneity

A few words of comment are in order about the single instance where the β_2 criterion has a value of less than three. This anomaly arises in the 1919 distribution for the Tanning Industry and gives the only U_1 curve type. An examination of the data as presented by the Federal Trade Commission in its report on this industry offers some explanation of the bi-modality of the 1919 distribution. Table XIII, in Ap-

pendix B, includes the Commission's findings with regard to the earnings of 89 tanners, divided into three groups. The groups are: sole leather tanners, upper leather tanners, and kid leather tanners. In the year 1919, the 22 concerns tanning kid leather had a rate of earnings on total investment of 81 per cent, the upper leather tanners 23.8 per cent, and the sole leather tanners 18.9 per cent. There seems to be little doubt, then, that the two modes giving rise to a U-shaped curve represent the heterogeneity of the distribution, and the distribution in 1919 does not appear to be comparable with our findings in other years.

Some Special Points Considered

At this point it is desirable to refer to the frequency polygons which were constructed from the empirical distributions[29] and to examine them in some detail, with reference to the curve types which were indicated for their graduation. A careful examination of these polygons, in the light of our knowledge of curve types, will in general reveal the following facts: (1) in almost every case the distributions reveal positive skewness; (2) extreme items are present in almost every distribution and are generally on the side of high earnings ratios, although there are some cases of extremely low earnings ratios; (3) the peakedness of most of the distributions is clearly evident, for the modal class generally contains about one-third of the total frequencies; (4) the modal class generally shows very little change even though the mean earnings ratio for the industry shows large changes; (5) in some instances the curve type does not seem to be warranted by the empirical distribution, and where such cases arise we find that one or two very extreme items account for the non-representative character of the curve type derived; (6) the distributions by average earnings for several years are not materially different from the yearly distributions.

Points (4), (5), and (6) above merit special attention. With

[29] See pages 87–95.

reference to the first, we must call to mind our general analysis of central position in terms of medians. Our general conclusion was that, excluding very unusual times, the position of the median earning rate for any industry approximated 10 to 12 per cent. At that point it might have seemed strange that modal rates were not used in place of median rates. Rough modes could have been calculated, but, in general, an inspection of the frequency distributions gives a sufficiently close approximation to such a mode, and we had contemplated computing the mode from the entire frequency distribution when we undertook the derivation of curve types. We are now in a position to present this material, but before we do so it is instructive to note the mid-points of the modal classes for the actual empirical distributions which we are analyzing. Sample 1 contains 43 distributions for 11 industries. If the 17 distributions for the Shoe Manufacturing, the Tanning, and the Steel industries are excluded, because they cover war-time years, we will find that with class intervals of ten per cent the most usual modal class has a mid-point of five per cent. This mid-point of five per cent appears 16 times in the remaining 26 distributions in Sample 1, and is tied with minus five per cent twice. The mid-point of minus five per cent for the modal class appears three times. This accounts for 21 of the 26 distributions. The remaining five distributions have modal classes with mid-points of 15 per cent, and are distributed as follows: two are in the Wheat Flour Milling Industry for the years 1919 and 1920; one is in the Stove Manufacturing Industry for 1920; one in the Retail Hardware Store distributions for the year 1920, and one in Retail Furniture Stores in 1920.

The immediate criticism is apparent. The class intervals of ten per cent are very large. If smaller intervals were used, however, the data would distribute themselves so widely that they would become unmanageable for presentation in tables; and the work of varying the class intervals of each distribution to find a more accurate approximate mode is almost always defeated by the appearance of two or more classes with

the same, or almost the same, frequencies. If we remember that all of our other measures for Sample 1 are computed from arrays and not from the frequency distributions, it will be apparent that our failure to use the mode earlier was defensible, and that the values of our other measures are not the result of the class intervals chosen to form the empirical frequency distributions.

Remembering, then, that our citation of the mid-points of the modal classes is only a rough approximation, we can go on with our presentation of this type of evidence. If the frequency distributions in the Public Utility Industry are examined, we find that for every year the mid-point of the modal classes is five per cent. As the class interval used here is only two per cent it is not subject to the criticism voiced above. This mid-point of five per cent will hold for the distributions of percentages of total assets by earnings ratios as well as for the numbers of corporations by earnings ratios.

We can also examine the data in Sample 3 in this same way. Here we have 160 frequency distributions for the period 1919 to 1928, inclusive. The class interval used is five per cent. Remembering the difference that exists between these distributions for the years 1919 to 1923 and 1924 to 1928, we can save time by merely citing the modal class evidence for the 80 distributions for the latter years. The most usual mid-point for these distributions is seven per cent, since it appears exactly 40 times among the 80 distributions. The next most usual modal class mid-point is twelve per cent, which appears 34 times. These two mid-points, then, account for 74 of the 80 distributions. Of the remaining six distributions, we find three with modal class mid-points of 17 per cent, two with a tie between the modal class mid-points of 12 and 17 per cent, and one with a modal class mid-point of two per cent.

The findings with regard to the mid-points of the modal classes can be fairly interpreted as supporting our earlier contention that the central value of an industry's earnings, excluding unusual times, is approximately ten per cent. This

statement, of course, does not include the Public Utility Industry. In Sample 1, the most usual mid-point for ten per cent class intervals was five per cent. The mode might very well be close to the top of this class. The most usual modal class mid-point for the years 1924 to 1928, in Sample 3, was seven per cent, although 12 per cent ran a close second. The true modal values might, therefore, run close to ten per cent. We may safely conclude, then, that no serious discrepancy exists between these two bodies of data.

The only body of data that allows us to compute modes from the entire frequency distribution is Samples 1 and 2. In the course of deriving the criteria of curve type, such modes were computed[30] and their values raised certain very interesting questions with respect to our empirical distributions and the Pearsonian curves which the criteria indicate to describe them. As an introduction to a consideration of point (5) raised above, we shall compare the modes derived by the Pearsonian method, the mid-points of the modal classes in the empirical distributions, and the mean and median values, noting in each case the curve type. These data are presented in Tables 16 and 17.

First examining Table 16 we see immediately several very unusual conditions. The first is in the Tanning Industry for the years 1915 to 1917, inclusive, and for 1919. The modal values derived by the Pearsonian formulas are quite some distance removed from the approximate modes given by the mid-points of the modal classes. The curves for the 1915 to 1917 distributions are J_1 in type. An examination of the frequency polygons (pages 87–95) and frequency distributions (Appendix B, Tables I and II) for this industry in these years shows that this is not an entirely irrational description. The modes for curves of this type give the value of the asymptote at which the frequencies become infinite and are thus significantly different from the mode in the usual bell-shaped curves. The distribution in 1919 is the U-type curve previously analyzed, and the mode in this case is an anti-

[30] For the formula used, see page 50.

TABLE 16

Modal Values, Mid-Points of Modal Classes, Means, and Medians*

(Federal Trade Commission Data)

Industry	Year	Mid-Point Modal Class	Modal Value†	Median	Mean	Main Curve Types‡	Possible Transition Types‡
Shoe Manufacturing	1914	15	10.49	13.69	15.29	IV H	
	1915	15	10.65	12.94	15.33	IV	
	1916	15	13.69	22.95	27.46	VI	
	1917	15	17.14	21.52	23.42	IV H	
	1919	15	16.7	26.2	29.9	I_I	III
	Av. 1914–17	15	10.95	17.70	20.39	I_I	III
Tanning	1914	5	11.49	10.30	11.95	IV H	VII H
	1915	15	.45	14.15	16.34	J_I	J_{III}
	1916	25	2.13	26.85	32.29	J_I	J_{III}
	1917	15	8.49	21.70	27.20	J_I	
	1919	15	40.2	32.7	48.9	U_I F	
	Av. 1914–17	15	13.27	18.30	21.17	VI	III
Steel	1915	5	2.0	8.8	12.1	I_I	III
	1916	25	−173.7	36.6	51.7	J_I F	
	1917	25	37.4	47.5	56.0	I_I	III
	1918	15	−97.3	18.6	31.0	J_I F	
	Av. 1915–18	35	9.8	32.7	37.8	J_I	
Wheat Flour Milling	1919	15	11.9	14.9	16.5	VI	V
	1920	15	13.5	11.6	11.4	IV H	VII H
	1921	5 and −5	3.3	−.2	−2.7	IV	
	1922	5	8.0	8.4	9.3	IV H	VII H
	Av. 1919–22	5	7.5	8.7	8.8	IV	VII
Petroleum Refining	1922	5	9.1	9.8	12.4	IV	
	1923	5	4.2	4.1	3.8	IV H	VII H
	1924	5	9.2	7.1	7.1	IV H	
	1925	5	10.8	7.9	7.8	IV	
	Av. 1922–25	5	9.7	7.8	7.7	IV H	
Crude Petroleum	1918	5	5.5	11.2	18.0	IV	V
	1922	−5	−86.3	.9	9.6	J_I	
	1923	5 and −5	−17.7	2.7	12.4	VI	V
	1924	5	3.6	4.8	12.0	IV	
	1925	5	−14.0	11.3	16.4	VI H	
	Av. 1922–25	5	−33.8	6.7	13.0	J_I	J_{III}
Southern Pine Lumber	1917	5	3.2	9.7	11.7	I_I	III
	1918	5	5.3	7.8	8.9	IV	
Stove Manufacturing	1920	15	18.2	17.4	18.2	IV H	VII H
	1921	−5	.6	.1	2.0	IV	VII
Retail Hardware Stores	1920	15	−11.5	18.3	25.3	J_I	
	1921	5	−175.2	5.0	10.9	J_I F	
Washing Machine Manufacturing	1920	5	9.4	12.1	17.0	IV	
	1921	−5	−3.7	−5.6	−5.9	IV	VII
Retail Furniture Stores	1920	15	14.3	18.3	21.5	IV	
	1921	5	4.5	6.2	7.0	IV H	

* See Table VII, Appendix B.

† See explanation in the footnotes to Table VII, Appendix B, for the instances where the median does not fall between the values for the mean and mode.

‡ The letter H following the curve type notations indicates that r was positive and 7 or less, while the letter F indicates that r was negative and numerically equal to 4 or less.

mode, giving the position of the minimum frequency between the two maximum frequencies. The distributions for the years 1915 to 1917 are good examples of an industry in a series of exceptional years. The mean and median earnings rates are high, but the extremely high rates for some few concerns are chiefly responsible, since the maximum frequencies are to the extreme left, and when the curve type is derived we secure a J-type curve. The curves, if fitted, would probably not graduate the data very well, but it is important to know that the criteria of curve type suggest this description for the data. The empirical distributions are near enough to the suggested shape to make us cognizant of the fact that even in the years which are extremely favorable to an industry the pull of forces to a low central value is so strong that the distributions lose their proverbial bell-shaped form and become approximations to the J type.

The second exception to be noted occurs in the Steel Industry in the years 1916 and 1918 and in the distribution for the average of the four years 1915 to 1918. In each of these instances the curve type derived is a J_1. An examination of the frequency polygons (page 89) and frequency distributions (Appendix B) for these years indicates once again that such a description is not entirely unwarranted and supports the general comments which were made with reference to the Tanning Industry. The extreme size of the negative modes merely indicates that the asymptotes of the theoretical curve have been forced to the left by the extreme positive items which brought about a large χ and standard deviation.

A third and slightly different condition is apparent in our distributions for the Crude Petroleum Industry in the years 1922, 1923, 1925, and in the average for the years 1922 to 1925. Here, again, negative modes appear, but not all of them are associated with J_1 curves. An examination of the frequency polygons (page 92) and frequency distributions (Appendix B) does not seem to indicate that the curve type derived is even reasonable in the light of the empirical distributions. The J_1 curve for 1922 can be explained only in terms

of the extreme positive items, one being as large as 241.8 per cent. These same extreme items appear for the years 1923 and 1925, but are partly offset by some extremely large negative items, so that the curves are derived as of Type VI rather than J_I or J_{VI}. The large positive skewness and standard deviation force the theoretical mode to the left into negative territory. These theoretical curve types offer suggestions that are really not so irrational as might appear at first sight. When the distributions of from 76 to 90 companies exhibit

TABLE 17

MODAL VALUES, MID-POINTS OF MODAL CLASSES, MEANS, AND MEDIANS*

(*Public Utility Data*)

Year	Mid-Point Modal Class	Modal Value†	Median	Mean	Main Curve Types‡	Possible Transition Types‡
1915	5	4.09	4.99	5.31	IV	V
1916	5	4.05	5.12	5.41	IV	V
1917	5	.17	4.69	5.11	J_{VI}	
1918	5	2.79	4.31	4.47	IV H	
1919	5	−.53	4.61	4.96	J_{VI}	V
1920	5	3.43	4.47	4.72	IV H	
1921	5	4.43	4.98	5.07	IV H	
1922	5	1.06	5.82	5.99	J_{VI}	
1923	5	4.55	5.36	5.88	IV H	
1924	5	3.53	5.32	5.60	VI	V

*, †, ‡ Same as Table 16.

means that deviate from medians by as much as 9.7 per cent and at the least by 5.1 per cent, the unreliability of any group characteristic is very apparent. When in three cases out of six the medians fall outside of a modal class of ten per cent and the range of items is from -135.7[31] to 281.9 per cent, the

[31] This negative earnings ratio of more than 100 per cent seems to contradict our statement that losses are restricted to 100 per cent. The investments for concerns in this industry were, however, corrected for accounts recording "discovery values." As a result, the losses might well be in excess of the investment when such corrections were made.

unreliability of central values becomes almost self-evident. Perhaps the production of crude petroleum is one industry in which the *possibility* of gains of large size completely overshadows the *probability* of gains and losses, and thus should truly be represented by modes which are negative in sign.

The only other examples of frequency curve modes for the Federal Trade Commission data which appear entirely out of line with the empirical modal group are found in the two yearly distributions for the Hardware Stores, and here again we find extreme differences between medians and modes and the J_I curve is derived. The frequency polygons (page 93) are not too far removed from this type to make the derivation absurd, and the presence of very extreme items is evidence supporting the general ideas of the characteristics describable by J curves.

Table 17, which presents this same type of information for the Public Utility Industry, shows several examples worthy of note. In particular, the years 1917, 1919 and 1922 are easily singled out, and we find that in these instances a J_{VI} curve is derived. An inspection of the frequency polygons (page 94) will show once more the presence of extreme positive items, although the J variety of curve seems to describe these distributions very poorly.

The other distributions in Samples 1 and 2 have modes which are in conformity with the approximate modes suggested by the mid-points of the modal classes. In all of these instances the evidence is rather clear that even when an industry is extremely prosperous the modal earning rate for that industry tends to remain relatively low. This conclusion is in general conformity with our earlier analysis of central position in which the median was used as the central value. At the same time, we have seen why the modal value is the best value to use theoretically, but almost impossible to use in an accurate form for all of our distributions. For those distributions in which it maintains its meaning *as a central value*, the mode supports our general conclusions regarding central position.

This rather extensive inspection of curve type for certain rather peculiar curve-type derivations has, in addition to supplying an analysis of the modal values, afforded a very good introduction to the fifth generalization arising from the general inspection of the empirical frequency polygons, viz., the presence of extreme items in almost every distribution. Perhaps these extreme items are representative of heterogeneous elements that do not properly belong to the general distributions. We remarked, at an earlier point, that we had no evidence on this point and so we had to include these items. If we had individual balance sheets and income statements for each company, we could study the companies on the extremes of the distributions and see whether, from these statements, we could discover any reasons for excluding the items. The nearest we come to this condition is in the Public Utility data, where we have a record of net earnings ratios, net income ratios, total assets, location, and type of company for each company. Furthermore, we have the names of these companies, and their published balance sheets and income statements can be secured from Moody's Manual. The other bodies of data merely allow us to identify the companies by number, and as a result we cannot investigate the status of the extreme items and compare them with the other items. Nevertheless, we have thought it worth while to attempt an elimination of certain items which appeared extreme when the data were grouped in frequency distribution form and to compare our analysis without the extremes with our analysis including the extremes.[32] In general, the items eliminated are all items which appear in the frequency distributions after a class of zero frequency appears. Since this statement is not universally true, the items eliminated for this type of analysis are indicated by being placed in italics in the frequency distributions appearing in Appendix B, Tables I and II. This elimination of extremes is undertaken

[32] In Appendix A, Part II, the reader will find an analysis, in some detail, of the possible reasons for excluding extreme items, with some comments on the significance of these difficulties.

for Samples 1 and 2 only, since Samples 3 and 4 have been analyzed as to central tendency, skewness, and dispersion by utilizing median and quartile measures only. As a result, the extreme items have had very little effect and the kurtosis and curve type analysis has not been attempted for these distributions.

In Table VIII, in Appendix B, we have recorded the statistical measures derived with the extreme items eliminated. We may inspect this table and compare the measures derived with those which resulted when all the items were included. In specifying curve type, we shall use the same convention that was used previously.[33]

As was to be expected, the position of the medians in the various distributions was not materially modified, so that we need not change our general conclusions with regard to the central values of these distributions. The same thing, in general, is true of skewness. Samples 1 and 2 before the elimination of any items from the individual distributions provided seven distributions with negative skewness. After the elimination of certain extreme items, only five of the 53 distributions show negative skewness. This difference in the number of distributions with negative skewness was not accomplished by the mere elimination of two negatively skewed distributions. Before eliminations, Sample 1 provides all of the seven examples of negative skewness, while after the eliminations only three of the distributions in this sample exhibit negative skewness. This decrease in the number of distributions with negative skewness was accomplished by changing the four instances of negative skewness in the Petroleum Refining Industry to positive skewness of small amounts. The Crude Petroleum Industry, which had previously provided no distributions with negative skewness, now exhibits negative skewness in the distribution for the year 1923. The Wheat Milling Industry previously accounted for two distributions with negative skewness, but

[33] See pp. 147.

one of these now becomes positive. The negative skewness in 1921 for the Washing Machine Industry remains unchanged in sign.

Two of the distributions for the Public Utility Industry now become negative in skewness, although of very small amount. In general, the effect upon the Public Utility distributions of the elimination of extremes is to make the distributions nearly symmetrical for all years except 1915, 1916, and 1917, where a material positive skewness still persists. We may say in summary, then, that positive skewness is even more pronounced after the elimination of extreme items than before such eliminations, with the Public Utility Industry as a possible exception.

The dispersion measures are slightly reduced in size, but the main effect is to make the dispersion measures from year to year more stable than before the eliminations. The largest single modification of previous findings arises in the kurtosis indications as given by the values of β_2. After extreme items are eliminated, β_2 is less than three for 10 distributions among the 43 in Sample 1, whereas before eliminations β_2 was less than three for only one distribution. In none of the distributions for the Public Utility Industry is β_2 less than three. These facts seem to indicate that our earlier suspicion is correct. The values of β_2 are large because of the effect of a few extreme items in the distributions. It is still true, however, that in general the distributions are more peaked than the normal distribution. Where β_2 is less than three, it is generally not less by very much.

In Table 18, which presents the new derivations of curve types, we notice immediately that for Sample 1 the Type I distributions are in marked ascendency, although the number of these distributions which are J-shaped has been materially reduced. For Sample 2, Type IV is even more predominant than before eliminations, and none of these distributions fall within the heterotypic area. Furthermore, only four of the entire 53 distributions have values of r which

are positive and seven or less, although five of the Type I distributions, of which two are J-shaped, have values of r which are negative and numerically less than four.

These indications seem to have some meaning. The Public Utility distributions, since they are nearly symmetrical with

TABLE 18

CURVE TYPES AFTER THE ELIMINATION OF EXTREME ITEMS*

(*Federal Trade Commission and Public Utility Data*)

Main Curve Types	Number of Distributions	
	Sample 1	Sample 2
I	26 (5F)† { 24 I_1 of which 12 might be Type III; 2 J_1 but both are very close to I_1 }	
IV	16 (4H) { of which 8 might be Type VII, 1 might be Type V, and 2 might be Type III }	7 { of which 5 might be Type VII }
VI	1 { which might be Type V }	3 { of which 1 might be Type III }
Total distributions	43	10

* See Table VIII, Appendix B, for the curve types for each distribution by industries.

† The numbers and letters in parentheses indicate the number of each curve type which have values of r which are positive and 7 or less, or negative and numerically less than 4. The letter (H) indicates positive measures, and the letter (F) negative measures.

extreme items out, seem to have a tendency to be describable by a Type VII curve, since in all instances β_2 is greater than three. It is the size of β_2 that prevents these distributions from approximating the normal curve. The distributions in Sample 1 have also become more symmetrical, and when β_2 is less than three they are classifiable as Type I or possibly

Type III or Type II. When the skewness is large, they move away from the Type III line and approach the area of J_1 curves.[34] Where the values of β_2 are above three, they fall below the Type III line into the area of Type VI or Type IV curves, which in some instances are close to the symmetrical Type VII. In all probability, the Type III curve would give a fair fit to more of the distributions than any other single curve type. On the whole, the distributions with extreme items out (and in very few cases do these items constitute as high as five per cent of the frequencies), the distributions cluster around the Gaussian point or the Type III curve much closer than would have been anticipated from our earlier discussion.

Point (6) mentioned on page 153 does not seem to have any definite explanation. It would have seemed reasonable to expect that the average yearly earnings ratios would be distributed somewhat differently from the yearly earnings ratios.[35] This generalization does not, however, appear to be true. In the Shoe Manufacturing and Steel Industries, the distributions for the averages are, in general, closer to Type III than the individual yearly distributions. For the Crude Petroleum Industry and the Wheat Milling Industry the distributions of the average earnings are more nearly symmetrical than the individual yearly distributions. In the Tanning and Petroleum Refining Industries, however, the distributions of yearly average earnings ratios furnish two Type I curves where r is very small numerically, although not less than four.

General Summary

We may now summarize the findings of this chapter. In general, our distributions of earnings ratios have central values which approximate 10 to 12 per cent. These distributions show positive skewness and have dispersion measures which seem large when we remember that we are dealing

[34] See Chart X, p. 146.

[35] See page 62 for the explanation regarding the type of distribution referred to here.

with ratios, since the most common inter-quartile range for the Federal Trade Commission data is ten per cent and for the Public Utility distributions approximates three per cent. These conclusions hold good whether certain extreme items are eliminated or not.

So far as entire industries are concerned, the evidence seems to show that they do not differ very much in their most representative earnings ratio measures, although different industries seem to show different degrees of dispersion.

In general, the distributions of earnings ratios for the individual industries show a concentration greater than that of the normal curve. These distributions are not describable by any one type of Pearsonian curve, although after extreme items are eliminated Type III would probably give a fair fit to most of the distributions. Since the value of r is seldom large, most of the distributions have elements which tend to make for instability, although r becomes larger when a few extreme items are eliminated.

CHAPTER IV

ATTRIBUTES OF FREQUENCY DISTRIBUTIONS OF EARNINGS RATIOS IN TIME

In discussing the relationship in time of attributes of frequency distributions by earnings ratios, we can proceed most logically by stating certain hypotheses and then examining them in the light of our data to test their validity or invalidity. In doing this, we may find it necessary, now and again, to study the relationship between these aspects in order to test further an original hypothesis.

Central Tendency and Skewness

Possible Hypotheses regarding Time Relationships between Central Tendency and Skewness

Our first proposal regarding the relationships between frequency distribution attributes in time is that the sign of the skewness and the direction of the change in the mean or median earnings might be associated; e.g., we might assume that if the mean earnings decreased the skewness would become negative, while if the mean earnings increased, the skewness would be positive. This suggestion would be based on the assumption that the change in the average was the result of uneven changes in the earning rates of individual concerns, some few concerns showing large changes, while most of them, though changing in a given direction, showed only small changes. Our analysis of skewness in space has shown, however, that with few exceptions the skewness is always positive in sign, so that we need not investigate this hypothesis. But a modification of this speculation immediately suggests itself. Perhaps the amount of skewness changes, so that when the average earning rate for an industry is decreasing, the amount of skewness becomes

smaller, and when the average earning rate is increasing the amount of skewness becomes larger. This possibility constitutes the subject matter of our first investigation into time relationships.

The meaning of such a relationship, if we discover its presence, should be made clear. If the measure of skewness selected is $(M-Md)$, then, if the amount of skewness varies directly with the *direction* of change in the mean, we know that the change in the mean is greater than the change in the median. In other words, the change in the mean is the result of an uneven change in the distribution as some few items change more than the others. If the measure of skewness is $(\mathcal{Q}_3-Md)-(Md-\mathcal{Q}_1)$, then the presence of the direct relationship between the amount of skewness and the direction of change in the median signifies that for increases in the median the upper quartile $\mathcal{Q}_3$ must increase more than the median and/or the lower quartile $\mathcal{Q}_1$ must increase less than the median. If the median decreases, the relationship is reversed. If we find, when using this measure of skewness, a positive correlation between an increase in the amount of skewness and the direction of change in the median, we know that the change in the central value is the result of an unbalanced change in the individual items. We can see, therefore, that a study of the relationship between a central value and skewness is a study of the presence or absence of balanced changes in the individual items. The measures of skewness for this purpose are better if not expressed in coefficient form, because the association of the mean with $\frac{M-Md}{\sigma}$ is spurious if changes in the mean are correlated with the standard deviation. The association of the median with $(\mathcal{Q}_3-Md)-(\mathcal{Q}_1-Md)/(\mathcal{Q}_3-Md)+(\mathcal{Q}_1-Md)$[1] includes the inter-quartile range as denominator, and if the median is associated with this measure of dispersion a spurious element is inserted here also.

[1] See page 58 for explanation of this measure of skewness.

Evidence on Changes in Central Tendency and Changes in Skewness

Table 19 summarizes our findings for all four samples. In the case of Sample 1, we find some correspondence between the direction of change in the mean and the increase or decrease in the absolute amount of skewness. All of the other samples fail to show any such correspondence. In the case of Sample 2, we must remember that the amount of skewness for these distributions is relatively slight, and when the extreme items are eliminated the distributions are approximately symmetrical, with the exceptions of the years 1915, 1916, and 1917. Furthermore, the changes in the means between successive years are slight. The distributions in Sample 3 were analyzed in two parts, since, as has been noted above,[2] the distributions for the years 1919 to 1923 are different in composition from those for the years 1924 to 1928. Each of these two sets of distributions supplied four yearly changes in the median earning rates for the 16 major industrial divisions, or 128 changes in all. It was possible, however, to compute only 124 changes in the skewness measures because the lower quartiles in the distributions for Major Groups 6 and 10 in the year 1921 fall in an open class interval. This fact explains the difference between the total changes recorded for the divisions of Sample 3. Sample 4 is based upon the analysis of the frequency distributions giving percentages of total assets by earnings ratios rather than numbers of concerns by earnings ratios.

The entire body of data taken collectively shows rather conclusively that little correlation exists between the direction of change in the central values, means, or medians and the size of the measure of skewness. We must conclude, therefore, that the distributions of earnings ratios, although positively skewed in general, do not show increases in skewness when the central value increases, or decreases in skewness when the central value decreases. The only body of data which supports the hypothesis at all is Sample 1, and

[2] See pages 82, 83, and 123, 124.

this is true after the elimination of extreme items from the distributions as well as before such eliminations. The thought which then presents itself is that, although the amount of skewness for the earnings ratio distributions does not change

TABLE 19

ASSOCIATION BETWEEN CHANGE IN THE CENTRAL VALUE AND CHANGE IN SKEWNESS*

(*All Four Samples*)

Change†	Sample 1 Central Value= Mean Measure of Skewness= $M-Md$		Sample 2 Central Value= Mean Measure of Skewness= $M-Md$		Sample 3 Central Value= Median Measure of Skewness= $(Q_3-Md)-(Md-Q_1)$		Sample 4 Central Value= Mean Measure of Skewness= $M-Md$
	All Items	Extremes Eliminated‡	All Items	Extremes Eliminated‡	Distributions 1919–23	Distributions 1924–28	Distribution of Percentages of Total Assets
Increase in Central Value	11	10	4	5	25	22	7
Increase in skewness	8	7	2	2	12	9	3
Decrease in skewness	3	3	2	3	13	13	4
No change in skewness	0	0	0	0	0	0	0
Decrease in Central Value	12	13	5	4	34	41	15
Decrease in skewness	9	10	3	2	23	18	10
Increase in skewness	3	3	2	1	10	20	5
No change in skewness	0	0	0	1	1	3	0
No Change in Central Value	0	0	0	0	1	1	0
No change in skewness	0	0	0	0	0	0	0
Increase in skewness	0	0	0	0	0	0	0
Decrease in skewness	0	0	0	0	1	1	0
Total changes	23	23	9	9	60	64	22

* Consult Tables V, VI, VII, and VIII in Appendix B, for the individual measure from year to year.

† A numerical decrease in a negative measure of skewness is recorded as an increase in positive skewness.

‡ For the items eliminated see italicized frequencies in Tables I and II, in Appendix B.

in the same direction as the mean, the *individual changes* in earnings ratios, if placed in frequency distribution form, might show skewness which varied with the mean change. This possibility should be investigated.

Some of the material provided in Sample 1 makes it possible to compute the amount of change in the rate of earnings for individual concerns between successive years. Such a procedure is possible for nine industries and provides 19 distributions in all.[3] The same procedure has been applied to Sample 2 and provides an additional nine distributions.[4]

The various statistical measures derived from this material are presented in Table XI, in Appendix B. It should be noted that the means of these distributions are the arithmetic averages of the individual changes between the successive years. The size of these means, therefore, indicates the extent of the change in earnings for the industry as a whole between the two years. These means will agree with the differences between the successive means for the distributions just analyzed, except where the number of concerns in the two years is not the same.

These data show a definite relationship between the sign of skewness and the sign of the mean of the changes. Analyzing Table XI, in Appendix B, we see that for the ten positive means for the 19 distributions in Sample 1 data we have eight corresponding positive measures of skewness, leaving only two cases where a negative skewness is associated with a positive mean. For the nine cases where the mean is negative, the skewness is negative seven times. The evidence in this instance seems to warrant the conclusion that when earning rates in an industry are increasing, the distributions of numbers of concerns by the amount of the individual changes show that a few concerns increase their earning rates greatly; while when earnings in the industry, as measured by the mean of the changes, are decreasing, a few concerns show large decreases.

Although the distributions based upon yearly changes in individual concerns' earnings ratios have not been analyzed in detail as yet, we must note here that extreme items are present in these distributions, also, and if eliminated might

[3] See Table X, Appendix B.
[4] See Table IX, Appendix B.

give significantly different results. Such extremes have been eliminated on the same basis as the extremes in the earnings ratio distributions[5] and the results recorded in Table XII, in Appendix B. Examination of this table for the correspondence between the sign of the mean change and the sign of skewness makes the relationship quite evident. For the 11 instances where the mean of the changes is positive the sign of skewness is positive. For the eight means which are negative we find seven corresponding negative measures of skewness. This evidence is even stronger and indicates clearly that the system of changes in individual companies' earnings ratios is skewed in the direction of the mean of such changes. In only two instances would the results have changed if we had associated the sign of skewness with the sign of the median of the changes.

The difficulty with this evidence is that Sample 1 supported the hypothesis best under the first type of analysis, so that we need evidence from the samples which were not favorable to the hypothesis to see if support for the general contention can be supplied from this new point of view. Since it is impossible to examine the data in Samples 3 and 4 in this manner, we must restrict our attention to Sample 2. It will be remembered that Sample 2 did not support the hypothesis at all when examined previously by the first method. When the distributions of earnings ratio differences are constructed and the values of the means and skewness measures computed, we find that with all items present the four positive means are associated with three positive measures of skewness, the one exception being negative ($-.01$). The five negative means are associated with five negative measures of skewness. If the extreme items are eliminated from the distributions of earnings ratio changes, we secure five positive means associated with four positive measures of skewness, and four negative means associated with four negative measures of skewness.

[5] See pp. 161–162 for the explanation of these eliminations.

Preliminary Summary of the Evidence on the Relationship between Changes in Central Tendency and in Skewness

These findings seem to indicate that the system of changes in individual earnings ratios is skewed in the direction of the means of those changes. It is unfortunate that we cannot extend this type of analysis to the other bodies of data, but must draw our conclusions from these two samples only. The writer leans to the conclusion that the system of changes would be skewed in this manner for the other bodies of data also if they could be analyzed. If so, how can we account for the fact that distributions of earnings ratios are generally positively skewed and that the amount of skewness between successive years does not increase or decrease persistently in direct correspondence with the direction of change in the mean, although the system of individual changes is generally skewed in the direction of the change?

Such a condition is possible only on the assumption that the internal positions of the individual concerns from year to year change so that the distribution of earnings ratios maintains a positive skewness, but that the internal movements of change are always skewed in the direction of the average movement. The failure of the size of skewness in the earnings ratio distributions to show the true nature of the skewness of the changes must be due to the reversal of movements among the individual items changing.

Permanence of Company Ranking in Successive Yearly Distributions

A certain amount of light can be thrown upon this problem if we analyze two aspects of the internal structure of the distributions from year to year. First, do concerns maintain the same ranking in successive yearly distributions? Second, do concerns which make high earning rates in a given year show changes in their earnings ratios between that year and the next which are less than the mean for a mean increase, and more than the mean for a mean decrease? An attempt to

answer the first of these two questions can take the form of rank correlation,[6] if the rank of the individual concerns in successive years can be obtained. This is possible for Samples 1 and 2 only. Table 20 presents the results and shows that some correlation does exist, but, with the exception of the Public Utility Industry, the correlation is very seldom high. Concerns do change their places in successive years.

To obtain a more significant indication of the percentage of positions in a second year that are explained by the rankings in the first year, we can square the coefficients of correlation.[7] We note that the coefficients for the different industries (Public Utilities excepted) range between .39 and .72, most of them being close to .5. This fact indicates that from 15 to 52 per cent of the positions in a succeeding year can be accounted for by the position in the preceding year, but that in general only about 25 per cent can be explained in this way. On the other hand, the Public Utility Industry shows that from 51 to 92 per cent of the ranking of concerns by earnings ratios in a succeeding year can be explained by the ranking in the first year, the general relationship accounting for about 64 per cent of the rankings.

More definite light can be thrown on this problem, however, if we attempt to answer the second question, and examine the relationship that exists between the earnings ratios of concerns in any one year and the change that takes

[6] This method involves the ranking of the individual items, squaring the differences between the rankings and then applying the following formula

$$r' = 1 - \frac{6\Sigma d^2}{N(N^2-1)}$$

where d represents the deviations and N the number of items. Karl Pearson has shown that if the original data from which the rankings are derived are distributed normally, then r' and r will be equivalent. We are not using r' as this type of measure, since we know that our items are not distributed normally but merely use it as a measure of disturbance in rankings.

[7] Since the distributions we are correlating are not normal our r' which is derived from the formula

$$r' = 1 - \frac{6\Sigma d^2}{N(N^2-1)}$$

is not equivalent to Pearson's r for the coefficient of correlation. As a result the interpretation of the square of the r' here used is not exactly correct but probably does not involve a very serious error if not interpreted too exactly.

TABLE 20

CORRELATION BETWEEN RANKS OF EARNINGS RATIOS IN SUCCESSIVE YEARS

(Federal Trade Commission and Public Utility Data)

Industry	Years	Coefficients of Rank Correlation	Number of Concerns
Shoe Manufacturing	1914–15	.68	237
	1915–16	.57	237
	1916–17	.48	237
Tanning	1914–15	.61	51
	1915–16	.63	51
	1916–17	.40	51
Steel	1915–16	.42	78
	1916–17	.41	78
	1917–18	.58	78
Petroleum Refining	1922–23	.60	58
	1923–24	.70	58
	1924–25	.54	58
Crude Petroleum	1922–23	.68	76
	1923–24	.62	76
	1924–25	.72	76
Southern Pine Lumber	1917–18	.56	111
Stove Manufacturing	1920–21	.40	78
Retail Hardware Stores	1920–21	.39	70
Washing Machine Manufacturing	1920–21	.49	35
Public Utility	1915–16	.96	92
	1916–17	.78	104
	1917–18	.76	115
	1918–19	.79	138
	1919–20	.85	152
	1920–21	.78	159
	1921–22	.82	164
	1922–23	.85	169
	1923–24	.86	170

place in those earnings ratios by the next succeeding year. In order to do this in a way which will allow some check by general inspection, two-way frequency tables have been prepared for all the data which made this comparison possible, and certain examples are presented in Appendix B, Table XVII. In this way, the earnings ratios within certain limits in one year can be compared with the changes in earnings ratios which the same concerns experienced in the next year. What are the possibilities which might result? We might find, first of all, that there is no difference with regard to the tendency of concerns with high earnings ratios to increase or decrease these ratios when compared with other concerns having lower earnings ratios. On the other hand, we might find that the concerns having earnings ratios which are high in a given year might, when earnings ratios in general were increasing, increase their earnings ratios more than the concerns which had lower earnings ratios in that same year, or we might find the opposite to be true. Again, concerns with high earnings ratios, when the industry as a whole increases its earning power, may increase their earnings ratios to a lesser extent than the industry as a whole, while concerns with low earnings ratios in any one year may increase theirs to a greater extent when the industry as a whole shows rising earning power. With few exceptions, it is the last of these three possibilities which is shown by the two-way frequency tables. This means that negative correlation is indicated between the size of earnings ratios in any one year and the amount of change in these earnings ratios in the succeeding year. Table 20 presents the coefficients of correlation, the means of the *changes* in the earnings ratios between the two years, and the means of the earnings ratios in the first year. In all but three instances, the coefficients of correlation for the distributions other than those for the Public Utility Industry were negative. The size of the coefficient is seldom large, but the persistence of the negative sign is more significant.

The Public Utility data show the negative relationship

TABLE 21

COEFFICIENTS OF CORRELATION BETWEEN EARNINGS RATIOS IN A GIVEN YEAR AND AMOUNT OF CHANGE IN THE EARNINGS RATIOS IN THE SUCCEEDING YEAR

(*Federal Trade Commission and Public Utility Data*)

Industry	Years	Number of Concerns	Coefficients	Means of the Changes in Earnings Ratios between the Years	Means of the Earnings Ratios in the Earlier Year
Shoe Manufacturing	1914–1915	237	−.42	.03	19.96
	1915–1916	237	−.35	12.14	15.43
	1916–1917	238	−.54	−4.24	27.69
Tanning	1914–1915	52	−.27	4.24	12.12
	1915–1916	52	.35	16.16	17.12
	1916–1917	52	−.83	−4.80	42.12
Steel	1915–1916	78	.23	40.26	12.57
	1916–1917	78	−.47	3.85	51.80
	1917–1918	78	−.42	−25.07	56.03
Petroleum Refining	1922–1923	58	−.46	−8.96	12.07
	1923–1924	60	−.70	3.00	3.50
	1924–1925	63	−.46	1.83	7.07
Crude Petroleum	1922–1923	76	−.33	1.71	9.48
	1923–1924	83	−.80	−1.50	12.59
	1924–1925	90	.20	4.34	11.78
Stove Manufacturing	1920–1921	78	−.41	−16.66	18.47
Retail Hardware Stores	1920–1921	70	−.39	−14.85	24.72
Washing Machine Manufacturing	1920–1921	35	−.57	−23.85	17.00
Southern Pine Lumber	1917–1918	111	−.43	−2.28	12.57
Public Utility	1915–1916	92	.25	.34	5.26
	1916–1917	104	.06	−.44	5.50
	1917–1918	115	−.09	−.63	5.16
	1918–1919	138	−.28	.16	4.76
	1919–1920	152	−.31	−.17	4.73
	1920–1921	159	−.18	.28	4.74
	1921–1922	164	.19	.80	5.10
	1922–1923	169	−.50	−.18	6.01
	1923–1924	170	−.34	−.19	5.78

only six times out of ten. This was to be expected, since the rankings of concerns by earnings ratios in successive years were more highly correlated than the rankings for the other industries.

Summary of the Permanence of Company Ranking

The meaning that may be attributed to these findings seems fairly evident. There is a tendency among concerns in a given industry to approach the average earning rate for that industry, which would indicate to some extent the force of competition. Such a conclusion is in line with Professor Secrist's studies.[8] It also offers some support for the conclusion that the kurtosis of distributions of numbers of concerns by earnings ratios is an indication of the forces of competition and that, if forces present at any given time were allowed to work themselves out, the kurtosis of these distributions would grow indefinitely large. The distributions by the actual earning rates in successive years are almost always characterized by positive skewness and large dispersion. This can only mean that there is enough internal disturbance within successive yearly distributions to offset the forces which would bring about a type of skewness in the distributions of the original earnings ratios corresponding to the direction of change in the mean. The forces governing earning rates in any period must be such as to prevent any significant negative skewness from developing. The universe of causes is characterized by definite traits favorable to individual concerns, but not always to the same concerns. There seems to be a set of "static" forces making for uniformity in earning rates, but also a set of "dynamic" forces which offset these tendencies and maintain the same general characteristics in the distributions by earning rates from year to year.

[8] Horace Secrist, *Competition in the Retail Distribution of Clothing*, Series II, No. 8, and *Expense Levels in Retailing*, Series II, No. 9, Bureau of Business Research, Northwestern University, Chicago, 1923 and 1924. Also *The Triumph of Mediocrity in Business*, Northwestern University Business Studies, Bureau of Business Research, Northwestern University, 1933.

Permanence of the Ranking of Different Industries in Successive Years

Having established this type of relationship between the earnings of individual concerns, we find ourselves faced with another problem of very great interest. In preceding chapters, we analyzed the general position of the median earn-

TABLE 22

RANKINGS OF MEDIAN EARNING RATES FOR EACH MAJOR INDUSTRIAL GROUP IN THE YEARS 1919 TO 1928 WITH THE COEFFICIENTS OF CORRELATION RELATING TO THE RANK CORRELATION BETWEEN SUCCESSIVE YEARS*

(*Source Book of Industrial Profits Data*)

Major Group	Yearly Rankings (High to Low)									
	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928
1. Food	8	13½	2	2	9	4	9	6	4	4
2. Textiles	1	13½	3	3	7	6	10	15	7	15
3. Leather	3	15	11½	10	15	13	14	12	2	8
4. Rubber	7	16	16	9	12	11	1	10	6	16
5. Lumber	11	3	11½	4½	2	5	5	8	15	10
6. Paper and Pulp	10	1	13½	11½	11	12	11	11	8	12
7. Printing	12½	2	1	1	3	1	2	1	1	1
8. Chemicals	12½	10½	9	4½	10	7	6	4	3	2
9. Stone and Clay	14	6	4	8	1	2	3	2	10	5
10. Metal	6	5	15	14	5	10	4	3	11	3
11. Scientific Inst., etc.	5	7	6	7	4	3	8	5	5	6
12. Retail Trade	2	9	5	6	6	8	7	7	9	7
13. Wholesale Trade	9	10½	13½	15	13	14	16	16	16	14
14. Retail and Wholesale	4	4	8	11½	8	9	12	13	12	13
15. Extractive	16	8	10	16	14	16	13	9	13	9
16. Banking	15	12	7	13	16	15	15	14	14	11
Coefficients of Rank Correlation		−.27	+.03	+.66	+.55	.67	.76	.42	.46	

* See Table 10, page 129 for the actual median values.

ing rates of different industries and noted that when unusual conditions are absent they tend to group themselves around 10 to 12 per cent. Our most specific illustration of this point was drawn from the median earnings rates for the 16 major industrial divisions in Sample 3. These industrial divisions provided median earning rates for a ten-year period and allowed us to calculate the mean, median, skewness, and

standard deviation of the 16 medians in each of the ten years. The point that interests us here refers to the rankings of these median earning rates for the individual major divisions in successive years. We should like to know whether or not the different industrial groups maintain their position in the successive yearly distributions of median earning rates. Table 22 provides the rankings of the medians for each industrial division in each of the 10 years and the coefficients of rank correlation between successive years. The first five years are separated from the last five for the reasons previously developed.[9] The conclusion to be drawn is almost self-evident. In disturbed periods (1919–1920), the industrial divisions suffer significant shifts in position and tend to place certain high ranking industries in a low position, so that the correlation becomes negative. In other years, there is some tendency to maintain a given ranking, but in general the correlation is low. The highest coefficient would allow us to predict only 58 per cent of the rankings in a succeeding year if we knew the rankings in the preceding year, while in general our prediction would hold good for only about 25 per cent.

Another question immediately suggests itself: do the major industrial divisions which have a high median in one year change in the succeeding year in such a way as to show a smaller increase if the average earning rate for all of the divisions is increasing, and a larger decrease if the average earning rate for all divisions is decreasing? In other words, is there a tendency toward the central value of the group for industries as well as individual concerns within an industry? In order to answer this question, the rankings of the major divisions by median earnings ratios in a given year have been correlated with the rankings of changes in the median earning rates between that year and the succeeding year. In this way, we secure four coefficients of rank correlation for the distributions covering the years 1919 to 1923 and four for the years 1924 to 1928. In every instance except one, these

[9] See p. 66.

coefficients of correlation are negative. Table 23 presents these coefficients with the mean values of the distributions of medians in the first year, the change in this mean value between that year and the succeeding one, and the standard deviation of the median values. An examination of Table 23 offers some rather striking suggestions. In the years when the means of the 16 medians are high and the standard deviation

TABLE 23

COEFFICIENTS OF RANK CORRELATION BETWEEN THE MEDIAN EARNING RATES OF THE SIXTEEN MAJOR INDUSTRIAL GROUPS IN A GIVEN YEAR AND THE AMOUNT OF CHANGE IN THEIR MEDIAN EARNING RATES BETWEEN THAT YEAR AND THE SUCCEEDING ONE, WITH CERTAIN OTHER STATISTICAL CONSTANTS

Years	Coefficients of Rank Correlation	Means of the Medians in the Earlier Year*	Changes in the Means between the Years*	Standard Deviations of the Medians in the Earlier Year*
1919–1920	−.77	25.2	−7.3	6.6
1920–1921	−.88	17.9	−9.0	7.7
1921–1922	−.75	8.9	+7.1	3.8
1922–1923	−.44	16.0	−1.1	2.7
1924–1925	−.56	12.6	+ .3	2.4
1925–1926	+.01	12.9	− .9	2.3
1926–1927	−.82	12.0	− .9	2.1
1927–1928	−.20	11.1	− .7	1.6

* See Table 10, p. 129.

indicates a large dispersion, and when the change in the average earnings between the two years is large, the correlation indicated in Table 23 is large and negative, thus indicating the tendency of competition to bring about an equality among the earning rates of the different major industrial groups. Even in the years when these conditions are not present, the general tendency is for the correlation to be negative. It is instructive to compare the coefficients of correlation in Table 23 with those in Table 22. When, between two years, the industries show stability in ranking, the co-

efficient of correlation showing the relationship between the earnings ratios of one of those years and the amount of change in those ratios between that year and the next cannot be high and negative. On the other hand, the absence of positive correlation in ranking does not necessarily mean negative correlation between median earnings ratios in one year and the amount by which they change by the succeeding year. The calculated coefficients are in line with this *a priori* conclusion.

General Summary of the Relationship between the Changes in the Mean and Skewness

We may conclude the section of this chapter devoted to the relationship of the changes in the mean values and skewness with a very brief review before passing on to the next topic. In general, the evidence does offer some support for the hypothesis that when the distributions of earnings ratios for a given industry show an increase in their averages the individual changes are skewed in the direction of the mean change. Furthermore, this system of changes does not maintain the different concerns in the same rank; the different earning rates tend to approach the mean. This tendency is always offset by other forces, however, so that year after year the distributions of earnings ratios are positively skewed. In general, the same conditions are true of the median earning rates for industrial divisions if the evidence we have before us is representative.

Central Tendency and Dispersion

Hypothesis regarding Changes in Central Tendency and in Dispersion

In line with our hypothesis regarding the possible relationship between changes in the central value and skewness, a suggestion regarding the relationship between the central value and dispersion affords a second hypothesis. Changes by significant amounts in the average earning rates of an industry may imply that a material disturbance is at work and

hence the degree of variability among earning rates should increase. This suggestion assumes that the variability of earning rates for the distributions of numbers of individual concerns in a given industry is definitely associated with disturbances and that these disturbances are indicated by changes in the average earning rate for the industry. This possibility must be investigated. Furthermore, a study of the relationship in time between central tendencies and dispersion will allow us to develop our generalizations regarding the central tendency and skewness to a much greater extent. Since we are studying the relationship between a central value and the dispersion, it will be better, in order to avoid spurious correlation, if we use the measure of dispersion in absolute form and do not divide it by the central value.

Evidence on the Relationship between Changes in the Central Value and Dispersion

To facilitate the drawing of conclusions, Table 24 has been prepared. From it we see that little relationship exists between the direction of change in the central values and in dispersion. This conclusion holds with extreme items eliminated as well as with extreme items present. The question must be raised, then, whether we were really correct in comparing the changes in the central value with changes in the absolute measure of dispersion rather than with the coefficient of dispersion.

In general, the dispersion of different distributions is given as a percentage of the means of those distributions, because in most instances we seem to be warranted in assuming that there is a generic relationship between these two measures. If we wished to compare the dispersion of a distribution recording the weights of elephants with the dispersion of a distribution recording the weights of monkeys, we should probably assume that the means of the weights, as the central tendency in each distribution, were definitely associated with the variations around them, and when a comparison of dispersion was asked for we should state the measures as

TABLE 24

ASSOCIATION BETWEEN THE CHANGE IN THE CENTRAL MEASURE AND THE CHANGE IN THE DISPERSION*

(*All Four Samples*)

Change	Number of Instances							
	Sample 1 Central Measures = Mean Dispersion = σ		Sample 2 Central Measures = Mean Dispersion = σ		Sample 3 Central Measures = Median Dispersion = $Q_3 - Q_1$		Sample 4 Central Measures = Median Dispersion = $Q_3 - Q_1$	
	All Items	Extremes Eliminated†	All Items	Extremes Eliminated†	Distributions 1919–23	Distributions 1924–28	Distributions of Numbers of Concerns	Distributions of Percentages of Total Assets
Increase in Central Measure	11	10	4	5	25	22	4	8
Increase in dispersion	5	6	3	2	16	11	0	3
Decrease in dispersion	6	4	1	3	9	11	4	5
No change in dispersion	0	0	0	0	0	0	0	0
Decrease in Central Measure	12	13	5	4	34	41	18	13
Decrease in dispersion	7	7	3	4	30	19	10	9
Increase in dispersion	4	5	2	0	4	18	6	4
No change in dispersion	1	1	0	0	0	4	2	0
No Change in Central Measure	0	0	0	0	1	1	0	1
No change in dispersion	0	0	0	0	0	0	0	0
Increase in dispersion	0	0	0	0	0	0	0	1
Decrease in dispersion	0	0	0	0	1	1	0	0
Total Changes	23	23	9	9	60	64	22	22

* These changes can be calculated from Tables V, VI, VII, and VIII, in Appendix B.
† See Tables I and II, in Appendix B, for the items eliminated.

percentages of their means. But we know that the means of our distributions are not representative central tendencies and have some reason to believe that other measures, such as the median or mode, exhibit a type of behavior not related

in any way to the variations around them. In other words, our distributions of earnings ratios are not examples of a balanced play of forces, and consequently the central tendencies do not bear the same relationship to the forces making for variation around the central tendency as would be found in a normal distribution. If the remaining evidence on dispersion supports this general interpretation, then one point that continually reappears in our discussions is given added emphasis. The central aspects of distributions of earnings ratios are not connected intimately with the variations around them; continually recurring sporadic elements indicate the profit-making forces, while the central tendencies show the working-out of the competitive or static forces.

Table 25 presents the relationships between the change in the mean and the change in the coefficient of dispersion and shows distinctly that the dispersion of the distributions does not vary directly with the central measure. We already know that in some instances (roughly about half the cases) the absolute dispersion does not vary directly with the central measure. We now know that when the absolute dispersion does vary directly, the change is not proportional to the change in the central measure, whether the central measure taken is the mean or the median. This statement holds good for the distributions of percentages of total assets by earnings ratios as well as the distributions of numbers of concerns by earnings ratios. It holds when the extreme items are eliminated from the distributions in Samples 1 and 2 as well as when they are present.

Before drawing our conclusions with regard to the evidence on dispersion and change in the central measure, one other method of analysis should be commented upon. In our discussion of skewness and change in the central value we introduced evidence drawn from distributions based upon the changes in earnings ratios between successive years and not upon the earnings ratios themselves. These distributions were analyzed with all items present and with extremes eliminated and the various statistical measures recorded in Tables

TABLE 25

ASSOCIATION BETWEEN THE CHANGE IN THE CENTRAL MEASURE AND THE CHANGE IN THE COEFFICIENT OF DISPERSION

(*All Four Samples*)

	Sample 1 Central Measure = Mean Coefficient of Dispersion = σ/M		Sample 2 Central Measure = Mean Coefficient of Dispersion = σ/M		Sample 3 Central Measure = Median Coefficient of Dispersion = Q_3-Q_1/Md		Sample 4 Central Measure = Median Coefficient of Dispersion = Q_3-Q_1/Md	
	All Items	Extremes Eliminated	All Items	Extremes Eliminated	Distributions 1919–23	Distributions 1924–28	Distributions of Numbers of Concerns	Distributions of Percentages of Total Assets
Increase in Central Measure	11	10	4	5	25	22	4	8
Increase in coefficient of dispersion	2	1	0	1	2	6	0	0
Decrease in coefficient of dispersion	9	9	4	4	23	16	4	8
No change in coefficient of dispersion	0	0	0	0	0	0	0	0
Decrease in Central Measure	12	13	5	4	34	41	18	13
Decrease in coefficient of dispersion	2	2	2	1	9	7	6	4
Increase in coefficient of dispersion	10	11	3	2	23	32	12	9
No change in coefficient of dispersion	0	0	0	1	2	2	0	0
No Change in Central Measure	0	0	0	0	1	1	0	
No change in coefficient of dispersion	0	0	0	0	0	0	0	0
Decrease in coefficient of dispersion	0	0	0	0	1	1	0	0
Increase in coefficient of dispersion	0	0	0	0	0	0	0	1
Total Changes	23	23	9	9	60	64	22	22

XI and XII, in Appendix B. Without burdening the text with a complete analysis of the sign of the means for these distributions and the change in the absolute and relative measures of dispersion, it will suffice to point out that the standard

deviations (σ) are not, in general, associated in the direction of their change with the sign of the mean. The reader may examine Tables XI and XII, in Appendix B, and check this conclusion. The remarkable aspect of the standard deviation is its size. After extreme items are eliminated the standard deviations are much smaller, but even then they are as high as 35 per cent and frequently around 12 per cent for mean changes as low as four per cent. An analysis of the relationship of the mean change to the change in the coefficients of dispersion for these distributions of earnings ratio changes cannot be given much weight because the means often approach close to zero, so that the coefficients are almost certain to become very large. Consequently, the fact that the coefficient of dispersion becomes larger for small means and smaller for large means does not have much meaning.

The distributions of yearly changes in earning rates also suggest that the systems of individual changes in earnings ratios for different industries may show widely different degrees of dispersion. The standard deviations for the Petroleum Refining Industry, as contrasted with the Crude Petroleum Industry, are a good example. In general, however, the important point is the general constancy of the size of dispersion, even though we have different degrees of changes in the mean. We must not forget, however, that three of the ten industries represented by distributions of yearly changes in earning rates are for wartime years only. It seems evident, therefore, that the sizes of the standard deviations for the Steel Industry, and probably for Shoe Manufacturing and Tanning as well, are much in excess of their ordinary values.

The suggestion about different degrees of dispersion for different industries is worthy of some attention since it has already been offered in Chapter III as a likely hypothesis. The reader will remember that we presented there ten yearly distributions of median earning rates and inter-quartile ranges for the 16 major industrial divisions in Sample 3. The distributions of inter-quartile ranges make it possible for us to rank the different industrial divisions by size of inter-quar-

tile range in each year and study the correlation by rank between the successive years. Furthermore, we can correlate by rank the position of each division in median earning rates and in inter-quartile ranges for each year and for the average of each five-year period.

TABLE 26

RANKING OF INTER-QUARTILE RANGES FOR EACH MAJOR INDUSTRIAL GROUP IN THE YEARS 1919 TO 1928 WITH THE COEFFICIENTS OF CORRELATION RELATING TO THE RANK CORRELATION BETWEEN SUCCESSIVE YEARS*

(*Source Book of Industrial Profits Data*)

Major Group	Yearly Rankings (High to Low)									
	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928
1. Food	3	11	6½	4	7	7	7½	5½	6	7
2. Textiles	4	5	3	5	13	9½	9	12	11	8
3. Leather	7½	14	6½	7	10	14	10	9	13	13
4. Rubber	13	15	10	10	15	11	13	3	5	2½
5. Lumber	5	4	11	3	9	6	7½	8	10	9½
6. Paper and Pulp	6	1	—	—	6	9½	12	11	9	12
7. Printing	9	2	1	1	2½	2	2	2	2	9½
8. Chemicals	2	7	2	2	1	1	1	1	1	1
9. Stone and Clay	11	6	5	6	4	3	3	10	8	4
10. Metal	7½	10	—	—	5	5	5	5½	7	5
11. Scientific Inst., etc.	14	13	4	9	8	4	4	7	4	2½
12. Retail Trade	1	12	13	11	12	13	11	13	12	11
13. Wholesale Trade	12	8	12	12	14	15	15	15	16	15
14. Retail and Wholesale	10	9	9	13	11	12	14	14	14	14
15. Extractive	15	3	8	8	2½	8	6	4	3	6
16. Banking	16	16	14	14	16	16	16	16	15	16
Coefficients of rank correlation	.23	.45	.73	.69		.94	.73	.93	.83	

* See Table 13, p. 138 for the actual inter-quartile ranges.

Permanence of the Ranking of Different Industries by Amounts of Dispersion

Table 26 presents these rankings of the inter-quartile ranges of the 16 industrial divisions in each year and the coefficients of rank correlation between the successive years, the distributions for the years 1919 to 1923 being kept separate from those for the years 1924 to 1928. With the exception of the three years from 1919 to 1921, the correlation in ranking is high. An inspection of the table shows that, with

only a few exceptions, the different industries show a very strong tendency to maintain the same rank from year to year. The three exceptional years seem to indicate that in disturbed periods the amount of dispersion of the different industries is materially altered from the usual amount. We must remember that our different industrial divisions are not new samples of the given industrial division each year, but the same concerns each year. We cannot be certain, therefore, that the industries differ consistently in amount of dispersion unless we make the assumption that even though the same concerns are present each year they are representative of the industrial division to which they belong. This does not seem to be too great an assumption to make. Furthermore, it is significant that a group of concerns in one industry show behavior patterns which are consistently different in a certain given characteristic.

Association Between the Ranking of Industries by Size of Central Value and Amount of Dispersion

If the rankings by amount of dispersion are correlated with the rankings by median earning rates for each of the years from 1919 to 1928, inclusive, the following coefficients are secured: .40, .65, .48, .62, .36, .71, .58, .68, .55, .40. To some extent, high dispersion is associated with high median earning rates. If we take the average of the medians and interquartile ranges for the period 1919 to 1923 and rank them and correlate these rankings, we secure .58 as the coefficient, and if we rank the averages for the period 1924 to 1928, we secure .76 as the coefficient. The interpretation of these results is difficult and cannot be very positive. We had already discovered that the different industrial groups did maintain their rankings by median earnings to some extent, but that the correlation was not high. We now know that the different groups maintain their rank by amount of dispersion to a much greater extent, and that to some degree their rank by amount of dispersion is associated positively with their rank by median earning rate.

Perhaps this relationship is purely mechanical, since, as we mentioned before, it might have been expected that distributions with higher central values would have larger dispersions when measured absolutely. This would be true, for instance, of normal distributions, because for these distributions $\sigma = \sqrt{npq}$, $M = np$, and $p = q = \frac{1}{2}$, thus making the standard deviation (σ) of two normal curves larger when the mean is larger. The same thing would be true of the inter-quartile ranges of normal distributions since, $\frac{1}{2}(Q_3 - Q_1) = .675\sigma$. On the other hand, for two normal distributions with unequal means, the dispersion taken relative to the central value would be smaller for the distributions with the larger means. This is clearly evident, since $\frac{\sigma}{M} = \frac{\sqrt{Mq}}{M}$ and $\frac{\frac{1}{2}(Q_3 - Q_1)}{Md} = \frac{.675\sqrt{Mq}}{M}$. Perhaps our distributions do not differ consistently in their relative measures of dispersions, and it may be true that the relative amount of dispersion is smaller for large medians and larger for small medians, so that instead of positive correlation between the median values and the relative dispersion we might find negative correlation. As a rough check on this possibility, the average absolute inter-quartile ranges for the 16 major industrial divisions in the years 1924–28 have been ranked and correlated with the rankings of the average inter-quartile ranges as percentages of their medians.[10] Some positive association is evident, but the correlation coefficient is only .41. Furthermore, if the averages of the 16 medians for the years 1924–28 are ranked and correlated with the ranks of the averages for the relative inter-quartile ranges, we secure $-.09$ as the coefficient of correlation.[11] When we correlated the paired rankings of these

[10] This correlation is partly spurious, and tends toward positive correlation since we are correlating the average of five inter-quartile ranges with a fraction which is based upon five other ratios in which the five inter-quartile ranges were used as numerators.

[11] This correlation is partly spurious, and tends toward negative correlation since we are correlating the averages of five medians with fractions based upon five other ratios in which the five medians were used as denominators.

averages for the medians and absolute inter-quartile ranges, we secured a coefficient of .58, so that the evidence seems to indicate that the large absolute measures of inter-quartile ranges are not generally large when expressed as relatives of their medians.

Another method of gaining a little more insight into the exact character of the relationship between the absolute inter-quartile ranges and the medians for the 16 major industrial divisions suggests itself, and seems worthy of some mention. Since the distributions are almost all positively skewed, it might be true that the inter-quartile ranges are large when the skewness is large. In order to test this hypothesis, the rankings of the medians for the 16 divisions in the years 1924–28 have been correlated with the rankings of the numerator of the Bowley measure of skewness. The numerator was used because the denominator is the inter-quartile range and would induce spurious correlation.[12] The coefficients of correlation are −.14, +.07, +.07, −.25, and +.63 for the years 1924 to 1928, respectively. This last finding seems to indicate that there is little consistent relationship between the size of the medians and the amount of skewness.

Summary of the Evidence on the Relationship between Changes in the Central Value and Dispersion

While the direction of change in the absolute amount of dispersion does not show a significant positive correlation with the sign of change in the mean or median, the relationship between the sign of change in these averages is inverse to the direction of change in the coefficient of dispersion. This latter conclusion merely indicates that, as compared with the changes in the averages, the dispersion remains relatively unchanged so that industries do seem to differ consistently in the amounts by which their earning rates are dispersed. Our coefficients of correlation based upon the ranking of the 16 industrial divisions by inter-quartile ranges in successive years support this finding substantially. Furthermore, the

[12] For an explanation of this measure, see p. 58.

high inter-quartile ranges are associated positively with the high medians, although the association does not hold when the inter-quartile ranges are expressed as percentages of their medians. We have also discovered that large dispersion is not associated with large amounts of skewness so that large median values cannot be associated with large amounts of skewness.

These new discoveries help to clarify the evidence developed in the previous section on skewness where we found some positive correlation between the ranking of industrial divisions by median earning rates in successive years, although median earning rates in one year were associated inversely with the changes in the medians which took place between that year and the next one. The results are not really contradictory and a reasonable hypothesis seems to be that there is not more shifting in the ranking of median earning rates because of the association between dispersion and the median. Since the industries do maintain their ranking by amount of dispersion there is a tendency towards permanence in their ranking by medians. In other words, a certain amount of derived relationship exists which gives a greater permanence to ranking by median earning rates than would appear if it were not for the permanence of the ranking by dispersion and the positive association between dispersion and the medians. This hypothesis gives support to the idea that there is a tendency for the different industries to earn the same rate, but the permanence of certain other conditions making for persistent differences allows some permanent differences in representative earning power.

Central Tendency and Kurtosis

Hypothesis regarding Changes in the Mean and Changes in the Size of β_2

We have now concluded our analysis of the relationship between two aspects of our frequency distributions and the central tendency in time. The next measure, kurtosis, suggests another hypothesis. We might expect that serious dis-

turbances bring about significant changes in the mean, break down the concentration of the distribution, and thus cause the measure β_2 to become smaller. This hypothesis has nothing to do with the sign of the change, for it would receive support so long as β_2 decreased with significant decreases or increases in the mean. It should be remembered, also, that we have other information on this problem of the relationship between changes in the mean and changes in the concentration of the data. In an earlier section in this chapter,[13] we noted that a study of the relationship between the earning rates realized by individual concerns and changes in earning rates which took place by the succeeding year indicated a tendency for concerns with high earning rates to approach more closely to the mean and for concerns with low earning rates to do likewise. Will this general conclusion be substantiated by a study of the change in the size of β_2 and the associated change in the mean? Table 27 presents, both before and after the elimination of extreme items, the associated changes in the means and β_2 where such associations are permissible, and provides the answer to our question. It will be remembered that, with one or two exceptions, the changes in mean earning rates were not materially affected by the elimination of extreme items, but that the changes in β_2 were materially altered. The values of β_2 did not show nearly so much variation with extreme items eliminated as they did before such eliminations. Furthermore, as was noted above, the distributions with extreme items eliminated do not always give a β_2 greater than three. Before the eliminations, we secured only one β_2 value less than three, and this appeared for the U-shaped Type I curve and was shown to be the result of heterogeneity in our data. After the eliminations, however, we secured ten β_2's with values less than three.

Evidence on the Relationship between Changes in the Central Measure and Kurtosis

Our specific hypothesis with regard to the relationship between mean changes and associated changes in β_2 was

[13] See pp. 174–178.

brought out through a consideration of the rankings of these changes. If our hypothesis was correct, we should expect large changes in the mean to be associated with decreases in

TABLE 27

ASSOCIATION BETWEEN CHANGES IN THE MEANS AND CHANGES IN THE β_2'S DERIVED FROM DISTRIBUTIONS OF NUMBER OF CONCERNS BY EARNINGS RATIOS*

(*Federal Trade Commission and Public Utility Data*)

Industry	Years	No Items Eliminated		Extreme Items Eliminated	
		Rank of Mean Change (Sign disregarded)	Rank of β_2 Change (Sign considered, largest plus to largest minus)	Rank of Mean Change (Sign disregarded)	Rank of β_2 Change (Sign considered, largest plus to largest minus)
Steel	1915–16	1	2	2	21
Steel	1917–18	2	6	1	3
Washing Machine	1920–21	3	18	3	13
Stove Manufacturing	1920–21	4	16	4	18
Tanning	1915–16	5	8	6	20
Retail Fur. Stores	1920–21	6	11	7½	2
Retail Hdwe. Stores	1920–21	7	3	5	12
Wheat Milling	1920–21	8	9	9	7
Shoe Manufacturing	1915–16	9	4	10	9
Wheat Milling	1921–22	10	17	11	19
Petroleum Refining	1922–23	11	10	13	5
Wheat Milling	1919–20	12	12	14	22
Tanning	1916–17	13	19	15	4
Crude Petroleum	1924–25	14	1	21½	15
Tanning	1914–15	15	5	19	6
Steel	1916–17	16	22	7½	14
Shoe Manufacturing	1916–17	17	7	16½	1
Crude Petroleum	1922–23	18	23	20	10
Southern Pine Lumber	1917–18	19	15	18	16
Petroleum Refining	1923–24	20	14	16½	17
Petroleum Refining	1924–25	21	13	21½	11
Crude Petroleum	1923–24	22	21	12	8
Shoe Manufacturing	1914–15	23	20	23	23
Public Utility	1921–22	1	2	1	7
	1917–18	2	7	2	9
	1918–19	3	6	5	5
	1920–21	4	5	4	4
	1916–17	5	1	3	3
	1923–24	6	4	6	8
	1919–20	7	9	7	6
	1922–23	8	8	9	2
	1915–16	9	3	8	1

* See Tables VII and VIII, Appendix B, for the values from which the changes were calculated.

β_2, while small changes in the mean would be associated with increases in β_2. If the changes in the mean are ranked from high to low *without* respect to sign and changes in β_2 are ranked from high to low *with* respect to sign, then the existence of negative correlation would support our hypothesis, since a small change in the mean would receive a low rank and be associated with a large increase in β_2 having a high rank. A mere inspection of Table 27 shows clearly that there is no such correlation either before the elimination of extremes or after such eliminations. The specific coefficients of rank correlation before and after the eliminations are .45 and .04 for the Federal Trade Commission data, and .20 and $-.57$ for the Public Utility data. In the Public Utility data after eliminations we secure some negative correlation, but in general the conclusion that this type of association is not present is self-evident.

If we examine the means and β_2's derived from the distributions of numbers of concerns by *changes in earnings ratios*, we come to about the same conclusion. In this instance the hypothesis will be supported if *large means* are associated with *small* β_2's and *small means* are associated with *large* β_2's. In order that the shift from one industry to another shall have no effect on our conclusions, we give the comparisons by industries. Table 28 presents this information. In only one instance, Petroleum Refining with extremes eliminated, do we have a perfect case of large means associated with small β_2's. In all of the other instances there is little consistent positive or negative correlation. Several industries had to be excluded from this comparison because only one distribution based upon changes in earnings ratios was available.

Summary and Interpretation of the Evidence on the Relationship between Changes in the Mean and β_2

Little doubt now remains regarding the truth of our hypothesis. The size of β_2 does not seem to decrease with large changes in the mean and to grow larger when the mean re-

mains almost unchanged. After considering very carefully the data analyzed, the writer does not feel that this result is strange or even particularly significant. Our analysis of the

TABLE 28

ASSOCIATION BETWEEN SIZE OF MEANS AND β_2'S DERIVED FROM DISTRIBUTIONS OF NUMBER OF CONCERNS BY CHANGES IN EARNINGS RATIOS*

(*Federal Trade Commission and Public Utility Data*)

Industry	Years	Extreme Items Present		Extreme Items Eliminated	
		Rank of Size of Mean (Sign Neglected)	Rank of Size of β_2	Rank of Size of Mean (Sign Neglected)	Rank of Size of β_2
Shoe Manufacturing	1914–15	3	2	3	2
	1915–16	1	1	1	1
	1916–17	2	3	2	3
Tanning	1914–15	3	2	2	1
	1915–16	1	3	1	2
	1916–17	2	1	3	3
Petroleum Refining	1922–23	1	1	1	3
	1923–24	2	2	2	2
	1924–25	3	3	3	1
Crude Petroleum	1922–23	$2\frac{1}{2}$	1	3	1
	1923–24	$2\frac{1}{2}$	3	1	3
	1924–25	1	2	2	2
Steel	1915–16	1	1	1	2
	1916–17	3	2	3	3
	1917–18	2	3	2	1
Public Utility	1915–16	4	4	5	6
	1916–17	3	3	2	2
	1917–18	2	7	3	8
	1918–19	6	9	6	5
	1919–20	8	8	8	7
	1920–21	5	6	4	9
	1921–22	1	2	1	1
	1922–23	8	1	9	3
	1923–24	8	5	7	4

* See Tables XI and XII, Appendix B, for the individual values from which the changes were computed.

relationship between changes in the mean and changes in the standard deviation and coefficient of dispersion has shown that the dispersion for distributions with larger means is not

relatively as large as the dispersion of distributions with smaller means. Since β_2 indicates the degree of concentration for a given distribution with reference to the normal distribution with the same standard deviation, we cannot really compare β_2's with changes in the mean if the dispersion does not change relatively to the mean. Furthermore, the great changes in curve type during periods when the mean is changing by large amounts offer another reason why the β_2's are not strictly comparable. An examination of the relationship between the β_2's and the β_1's in Table VI, Appendix B, shows rather clearly that large β_2's are associated with large β_1's and indicate skewness. Since skewness is not definitely associated with changes in the mean, β_2 cannot be associated with changes in the mean. The only conclusion that seems warranted from this analysis of β_2 is that in most instances the concentration in the distributions is greater than would have been found in a normal distribution with the same standard deviation. This finding is meaningful, then, only when the distributions by earnings ratios in each year are compared with the normal distribution and not when distributions by earnings ratios are compared one with another, unless they are alike in other attributes but not alike in respect to β_2. We now see how important it was to determine the curve types, for only by so doing could we have understood how variable the distributions by earnings ratios really are. It is still useful, however, to point out the common characteristics of these distributions when compared with the normal curve. Skewness, positive in sign, and a concentration greater than that of the normal curve are common characteristics of the various curve types realized, and this fact is significant. In other respects, however, the curve types differ materially, so that successive distributions cannot be compared with each other with any great rigor in terms of one of their common characteristics only, but each distribution, or all of them collectively, can be compared with the normal distribution.

This conclusion emphasizes still further the lack of any

definite relationship between changes in the mean and certain other characteristics based upon variation about the mean. Each of the preceding hypotheses has been based upon the idea that material changes in the mean indicate significant disturbances and should be correlated with those measures which indicate variation around the central measure. Thus far we have failed to verify a single one of these hypotheses in so far as the original distributions of numbers of concerns by earnings ratios are concerned. Perhaps the most valuable conclusion to be drawn from this failure is the lack of representativeness of mean changes in indicating the variations which are taking place in the underlying universe of causes. Such a conclusion is extremely suggestive when applied to time series analysis because it indicates that time series based upon averages may not reveal the underlying changes and disturbances for the bulk of the data. In some instances, extreme movements in the mean may be accompanied by changes in the form of the underlying distribution, while in other cases, when the mean changes very little, the other characteristics of the distribution may indicate great disturbance. Our findings, with regard to β_2 in particular, indicate that small changes in the mean do not make the mean more representative by building up a greater concentration around it.

These ideas suggest that we attempt the study of one more relationship between change in the mean and another characteristic of the distributions. The criterion r, as described in Chapter II, was to serve two purposes. First, it indicates the moment in the theoretical distribution which becomes infinite. Second, the fact that low moments become infinite indicates that the distribution is based upon unstable factors. We have already noted that most of our distributions are characterized by small r's and we can now see whether the sizes of the r's are related to the amount of change in the means. In other words, are the distributions more stable after small changes in the means?

TABLE 29

CHANGES IN THE MEAN AND CHANGES IN STABILITY AS MEASURED BY THE CRITERION r FOR DISTRIBUTIONS OF NUMBER OF COMPANIES BY EARNINGS RATIOS*

(*Federal Trade Commission and Public Utility Data*)

Industry	Years	All Items		Extremes Eliminated	
		Change in Mean	Change in r	Change in Mean	Change in r
Shoe Manufacturing	1914–15	+.04	+3.47	−.17	.95
	1915–16	+12.13	+1.44	+11.88	+134.15
	1916–17	−4.04	−5.07	−3.70	−139.76
Tanning	1914–15	+4.39	+15.22	+2.60	+3.86
	1915–16	+15.95	+30.59	+14.76	−5.81
	1916–17	−5.09	−41.04	−3.89	+5.43
Steel	1915–16	+39.6	−7.10	+27.7	−8.82
	1916–17	+4.3	+147.70	+14.3	+.45
	1917–18	−25.0	−148.07	−29.6	+2.61
Wheat Flour Milling	1919–20	−5.1	−16.12	−4.5	−.36
	1920–21	−14.1	+1.30	−13.9	−1.88
	1921–22	+12.0	−1.89	+11.7	+.90
Crude Petroleum	1922–23	+2.8	+.71	−1.7	−4.57
	1923–24	−.4	+1.26	+10.5	+3.15
	1924–25	+4.4	−3.19	+1.5	−12.32
Petroleum Refining	1922–23	−8.6	−2.78	−7.0	+9.83
	1923–24	+2.3	+2.29	+3.7	−.78
	1924–25	+1.7	+.54	+1.5	+98.70
Southern Pine Lumber	1917–18	−2.8	−6.89	−2.8	−6.89
Washing Machine	1920–21	−22.9	+4.24	−21.9	+1.65
Stove Manufacturing	1920–21	−16.2	+6.57	−16.2	+6.57
Retail Furniture Stores	1920–21	−14.5	−2.86	−14.3	−13.67
Retail Hardware Stores	1920–21	−14.4	−3.92	−16.1	+20.03
Public Utility	1915–16	+.10	−2.15	+.09	−11.08
	1916–17	−.30	+6.43	−.52	+3.73
	1917–18	−.64	−10.16	−.67	−9.49
	1918–19	+.49	+20.43	+.26	0.00
	1919–20	−.24	−19.28	−.12	+.70
	1920–21	+.35	−1.11	+.31	−.67
	1921–22	+.92	+12.62	+.76	+15.38
	1922–23	−.11	−12.14	+.04	−15.22
	1923–24	−.28	+2.23	−.23	+14.29

* See Tables VII and VIII, in Appendix B, for the individual values from which these changes were computed.

Curve Type in Time

Changes in the Mean and Changes in r

Table 29 presents the necessary information about the relation between changes in the mean and in r by giving the amount and direction of changes in the mean and in r for the distributions by earnings ratios, both before and after the elimination of extreme items. The change in r is measured without reference to the sign of r. Without further analyses, Table 29 shows conclusively that but little relationship exists between the size of the mean change and the size of r. In very few instances do large changes in the mean bring about a decrease in the size of r, or small mean changes bring about an increase in r. This is true of the distributions after the elimination of extreme items as well as before such eliminations.

Table 30 presents the data from an entirely different angle since it gives the actual values of the means and r's for the distributions by yearly changes in earnings ratios. The means of these distributions would be identical with the changes in the means between the distributions of actual earnings ratios if the number of concerns were identical. In some instances, however, the original distributions by earnings ratios contain a different number of concerns in each year. When changes in the individual earnings ratios between years were calculated, we could include only those concerns which were present in both years. As a result, the means given for the distributions based upon changes in earnings ratios are not always identical with the differences between the means of the two distributions by earnings ratios, but are generally very close. Since the individual concerns in the Wheat Milling Industry and Retail Furniture Stores distributions could not be identified between years, distributions based upon the yearly changes in earnings ratios could not be constructed for these industries.

It might be expected that where the means of the distributions by changes in earning rates are small, the distributions would be more stable and show high values of r. The evidence

presented in Table 30 does not substantiate such an hypothesis. This is true for the Public Utility as well as the other distributions and holds good whether we include or exclude the extreme items of these distributions. The really striking fact

TABLE 30

CHANGES IN THE MEAN AND CHANGES IN STABILITY AS MEASURED BY THE CRITERION r FOR DISTRIBUTIONS OF NUMBER OF COMPANIES BY CHANGES IN EARNINGS RATIOS*

(*Federal Trade Commission and Public Utility Data*)

Industry	Years	All Items		Extremes Eliminated	
		Mean	r	Mean	r
Shoe Manufacturing	1914–15	.01	4.14	1.07	8.04
	1915–16	12.22	6.40	11.34	7.99
	1916–17	−4.04	5.66	−3.03	8.26
Tanning	1914–15	4.43	−6.93	4.43	−6.93
	1915–16	15.70	−1.37	15.70	−1.37
	1916–17	−4.99	5.23	−1.86	−122.98
Steel	1915–16	39.6	−3.87	30.7	−1.98
	1916–17	4.3	7.93	9.3	−4.13
	1917–18	−23.1	7.43	−24.3	−29.05
Crude Petroleum	1922–23	2.0	3.98	1.1	31.96
	1923–24	−2.0	5.48	4.6	16.21
	1924–25	4.5	4.71	3.3	9.30
Petroleum Refining	1922–23	−8.7	8.53	−7.1	−4.7
	1923–24	2.6	3.90	3.1	−19.2
	1924–25	1.7	5.47	2.8	5.4
Southern Pine Lumber	1917–18	−2.4	5.97	−2.7	9.6
Washing Machine	1920–21	−22.9	−18.19	−21.5	−3.5
Stove Manufacturing	1920–21	−16.2	12.55	−15.5	−5.88
Retail Hardware Stores	1920–21	−14.4	4.77	−14.3	−9.88
Public Utility	1915–16	.39	5.01	.34	4.89
	1916–17	−.41	13.11	−.61	5.26
	1917–18	−.62	3.55	−.57	9.07
	1918–19	.22	5.56	.27	5.75
	1919–20	−.18	4.43	−.12	6.48
	1920–21	.29	4.05	.41	9.95
	1921–22	.81	12.30	.63	11.92
	1922–23	−.18	−6.45	.08	2265.15
	1923–24	−.18	4.38	−.24	5.28

* See Tables XI and XII, in Appendix B.

is the small values of these r's in almost every case. With extreme items eliminated their values increase, but even under these conditions they remain relatively small. In general, they are smaller than the values of r derived from the distributions of numbers of concerns by actual earning rates. This fact would seem to indicate that the distributions of actual earning rates are generally more stable than the distributions based upon yearly changes in earning rates and that the system of changes in earning rates is subject to a larger number of unbalanced forces than the actual earning rate distributions themselves.

Summary and Conclusions regarding the Relationship between Changes in the Mean and r

Our conclusion with regard to changes in the mean and changes in r must be similar to the other conclusions which were reached when mean changes were compared with changes in the characteristics of variation about the mean. Distributions by earnings ratios are not more stable, if r is the measure of stability, when they follow small changes in the mean. Furthermore, distributions based upon the individual changes in earnings ratios do not show higher values of r when the mean change is small. Once more we find that changes in the mean are not good measures of other types of disturbances within the distribution itself.

Curve Types for Distributions Based on Changes in Earnings Ratios between Successive Years

In Chapter II, we analyzed the curve types derived from the distributions of numbers of concerns by earnings ratios before and after the elimination of extreme items. Since this chapter is concerned with the influence of the passage of time upon the earnings ratios of different industries, our discussion is not complete until we have analyzed the curve types which arise when our emphasis is upon individual changes in earnings ratios rather than upon the earnings ratios prevailing at any one time. In order that such a discussion might be in-

cluded, we have developed distributions based upon yearly changes in earnings ratios. Many of the characteristics of these distributions have already been introduced into the discussions in this chapter, so that we know in general that these distributions are skewed in the direction of the sign of the mean change, that the dispersion is relatively large and fairly constant in absolute amount, that β_2 is larger than three (although when extreme items are eliminated this is not universally true, since values less than three appear five times among the 28 distributions analyzed), and that r is very small.

We are now in a position to note the main curve types indicated and the possible transition types which the data permit within rough limits, based upon the inspection of the curve type constants. Table 31 presents this information for these distributions, both before and after the elimination of extreme items. In each instance, the number of distributions of each type which give positive values of r of seven or less is indicated, with the proper number preceding the capital letter H to indicate how many of them fall in the heterotypic area on the chart of curve types. If r is negative and numerically four or less, this fact is indicated by the capital letter F preceded by the number of times r has such a value. This is in conformity with R. A. Fisher's contention that the efficiency of the method of moments in locating and scaling J curves is very low. The information in Table 31 does not indicate the industries for which the various curve types were derived. Since this information can be obtained from Appendix B, Tables XI and XII, we did not burden the text table with it. Before the elimination of extreme items, the Type IV curve is the prevalent type, although 16 of the 19 distributions falling in this type have r's less than seven, so that no Pearsonian curve is really indicated by these distributions. Three of the 19 distributions are sufficiently symmetrical to be called Type VII, although two of the three have values of r less than seven. Three of the 19 give values of K_2 sufficiently close to one to make them possibilities for

Type V, although two of these have values of r less than seven.

If Table 31 is interpreted throughout in this same manner, the results are rather striking in their insistence on the instability of these distributions. The normal curve is never a very

TABLE 31

CURVE TYPES DERIVED FROM THE DISTRIBUTIONS BY CHANGES IN EARNINGS RATIOS*

(*Federal Trade Commission and Public Utility Data*)

Main Types	All Items	Extremes Eliminated
I	5 (2F)† { 4 J1; 1 I1 which might be classified as Type III	11 (3F) { 3 J1; 8 I1 of which 3 might be Type III and 3 Type II
IV	19 (16H) { 3 of which might be classified as Type VII and 3 as Type V	15 (6H) { 4 might be Type VII and 2 might be Type V
VI	4 (1H) { 1 of which might be classified as Type V	2 { 1 might be Type III and 1 Type V
Total distributions	28	28

* For the curve type of each distribution by industries consult Tables XI and XII, in Appendix B.

† The letters and numbers in parentheses indicate the number of distributions that give values for r of 7 or less when positive, or numerically 4 or less when negative. The letter (H) indicates positive values, while the letter (F) indicates negative values.

probable possibility and Type III appears as a possibility only five times out of a possible 56. When the extreme items are eliminated, we do not find so many instances in which r is seven or less, but an examination of Tables XI and XII, in Appendix B, shows that, with one exception, r is never large. Furthermore, it is not large amounts of skewness that account for this deviation of a majority of the distributions

from the normal or Type III distribution, since before the elimination of extremes three of the 28 were sufficiently symmetrical to make Type VII reasonable, while, after the elimination of extremes, four Type VII's and three Type II's are reasonable possibilities.

With reference to curve type and the different industries, nothing very definite can be said, since the distributions for the war years and the years 1920–21 are generally of the Type I variety irrespective of the industry. The Public Utility Industry shows rather clearly that if extreme items are eliminated from the distributions the yearly changes in individual earnings ratios are fairly symmetrical in distribution, but have a concentration much larger than would be found in normal distributions with the same standard deviations. The prevalence of concentration greater than that of the normal curve is generally true for the other industries, but, as we previously noted, some of them have β_2's less than three and thus show a concentration less than normal in terms of their standard deviations. In no instance is β_2 less than three before the elimination of the extreme items from the distributions. This decrease in the size of β_2 was to be expected since, as was previously explained, the elimination of extreme items will decrease the value of the fourth moment to a much greater extent than it does the value of the second moment, which is really σ^2. The remarkable aspect of the change is the continuation of large values of β_2 and not the dropping of β_2, in a few cases, below a value of three.

Summary and Interpretation of the Curve Types Derived

Distributions based upon individual changes in earnings ratios are apparently just as important for a correct analysis of industrial earnings as are distributions based, not upon the change in earning rates, but upon the actual rates themselves. It is certainly true that the way changes take place is just as important as the actual rates prevailing at any point in time. Our analysis of these data indicates, in a rather consistent way, that the changes in earning rates for individual

concerns between successive years are associated with a high degree of correlation between the sign of the mean changes and the sign of skewness. This finding surely means that when the earning rates for the industry as a whole are increasing, a few concerns show remarkably large increases, although many concerns may show little or no change. This fact would explain the large size of the standard deviation and the large size of β_2. When the earning rates for the industry as a whole are decreasing, an opposite type of skewness prevails, although the standard deviation and β_2 are still large, so that our conclusion is descriptive in both instances. We have already attempted to answer the question why distributions by changes in earning rates show a type of skewness directly correlated with the mean of the changes, although distributions by the actual earning rates continue to be positively skewed in almost all instances and the size of the skewness does not increase or decrease directly with the direction of the mean changes. Another question that arose, and was commented upon, concerns the correlation that exists between the ranking of concerns by their realized earnings ratios in successive years. To the explanation already advanced we may add another possibility. The degree of correlation we actually obtain may, in the light of the foregoing analysis, result from the fact that many of the concerns in the middle of the distributions show only a small amount of change while concerns on the ends of the distributions show a high degree of change. This explanation would account for the regressive tendencies of earning rates, the instability of distributions based upon individual changes in earning rates, and the high concentration of these distributions as shown by the size of β_2.

We have now completed our analysis of earnings ratios distributions, both in space and time, with extreme items present as well as absent. Our conclusions were not seriously modified when the extreme items were eliminated, since the only changes related to curve types and the size of β_2. When extreme items were eliminated from both types of distributions,

β_2 was not universally greater than three, although in general the distributions were leptokurtic. After the elimination of extreme items, there was a tendency for the most prevalent curve type to fall above the Type III line into the Type I area, instead of below the Type III line into the area of Type IV and Type VI distributions. In general, the value of r was larger, but not remarkably so. A larger number of distributions, after extreme items were eliminated, could have been reasonably classified as Type III or some other transition type, although no very probable normal distributions were present.

General Summary

Our analysis of the frequency distributions in time allows us to draw the following summary conclusions. The direction of change in the central measure is not generally associated with changes in skewness, dispersion, kurtosis, or stability. We have discovered, however, that the direction of change in the mean is directly associated with the skewness of the distributions based upon yearly changes in earnings ratio because the individual changes are skewed in the direction of the mean change. Furthermore, the absolute amount of dispersion seems to remain fairly constant for the different industries although the dispersion as a percentage of the central measure moves inversely to the direction of change in the mean. These findings seem to indicate that changes in the central values of earnings ratio distributions are not good indexes of other disturbances affecting the distributions. Our analysis of the internal structure of the distributions seems to indicate that although concerns do, to some extent, maintain the same position in successive distributions, there is a tendency for the concerns on the extremes to regress toward the center of the distributions. This conclusion is also warranted with reference to distributions based on the median earning rates for different industries. Further support for the conclusion that different industries tend to have similar average earning rates is derived from the discovery that dif-

ferent industries show a strong tendency to differ in the amounts to which their individual earning rates are dispersed while industries having large dispersion measures also have high median earning rates.

The distributions based upon individual changes in earnings ratios are very unstable, even when extreme items are eliminated; the dispersion measures are large and the curve types derived are generally far removed from either the normal or Type III distributions.

In general, we may conclude (1) that the changes in the central measures—means, medians, or modes—do not give an indication of other disturbances affecting the entire distribution of earnings ratios, (2) that changes in the earning rates of individual concerns between successive years show evidence of being influenced by a wide variety of elementary causes which make frequency distributions of these changes differ materially from the stable types, and (3) that there is a tendency for the individual concerns and industries to have common earning rates although at any time a large variety of rates actually exist.

One further task remains to be done before we can summarize our collective findings with regard to earnings ratio distributions and their significance for profit theory. This task, which will be attempted in the next chapter, is to point out the significant group characteristics of economic series other than earnings ratio distributions. In the course of this development, we shall be able to introduce certain series of cost data which are directly related to some of the earnings ratio distributions which have been analyzed in this and earlier chapters.

CHAPTER V

CHARACTERISTICS OF OTHER ECONOMIC SERIES

In an earlier chapter in which we discussed the conditions underlying the derivation of the normal curve, we introduced a quotation from Yule in which the following statement occurred:[1] "The comparative rarity of normal distributions in economic statistics is probably due in part to the fact that in most cases, while the entire causation is certainly complex, relatively few causes have a largely predominant influence (hence also the frequent occurrence of irregular distributions in this field of work), and in part also to a high degree of asymmetry in the distributions of the elements on which the compound variable depends." Professor P. Sargant Florence remarks that "skew distributions are often to be expected in the statistics of human events and social behavior for at least four sorts of reasons."[2] The four reasons given may be summarized as follows: (1) limits are often imposed on the value of the character at one end of the scale and not at the other, (2) contrivance by human agents may set a general standard which is to act as either a minimum or a maximum, (3) the selecting of the agent by human or natural forces may give a skew distribution, and (4) the "dint" of natural forces may also effect a skew as a result of changing conditions and institutions, since, during the change, sporadic elements are introduced into the causal universe. Without weighing these reasons carefully at present, we propose to make an examination of various types of economic data in an attempt to discover how distributions of these data differ from the normal distribution with respect to either skewness or kurtosis, or both.

[1] See page 41.

[2] P. Sargant Florence, *The Statistical Method in Economics*, p. 74.

Distributions of Income Data

Our analysis of earnings ratio distributions has shown that these distributions deviate from the normal type in both skewness and kurtosis. Probably the first other example of this type of deviation that would ordinarily be cited would be distributions of income. Although we have very little in the way of accurate distributions of income, we know enough about such distributions to be fairly certain that they show large positive skewness and high concentration around a modal value. This information would be much more valuable if we knew, also, that distributions of particular types of income were distributed in the same way. For instance, are wage incomes in general and are the wages of particular types of wage earners distributed in this way?

Without attempting to collect all of the information on this subject that is available, we may cite several examples in point. Professor Whitney Coombs,[3] in a study of the wages of unskilled labor, presents frequency distributions of hourly earnings for unskilled labor in four industries for the years 1907 and 1913. The industries are Blast Furnaces, Car Building, Lumber, and Woollen and Worsted Goods. All of these eight distributions show positive skewness, and by inspection alone seem to indicate a high degree of concentration, since the standard deviation is rather small with reference to the range of the distributions. Professor H. LaRue Frain[4] has presented information on hourly and weekly earnings for certain fairly standardized occupations in the metal working industries of Philadelphia for the year 1927. In general the average hourly and weekly rates paid by *different mills* employing workers in the specified occupations show variations which distribute themselves in a fairly symmetrical fashion. In some instances the distributions are negatively skewed

[3] Whitney Coombs, *The Wages of Unskilled Labor in Manufacturing Industries in the United States, 1890–1924*, Chapter IV.

[4] H. LaRue Frain, "Two Errors in Interpreting Wage Data," *American Economic Review*, September, 1929; "Wage Levels Between Firms," *American Economic Review*, December, 1931; and "Base Rates vs. Bonus Payment in Wage Comparisons for Standard Machine-tool Occupations," *The Personnel Journal*, October, 1931.

and in other instances positively skewed, but the amount of the skewness is generally small. If the firm averages are weighted by the number of men employed in each occupation, the resultant average is generally smaller than the unweighted averages, and this fact indicates that those concerns employing the smallest number of men pay the highest average hourly or weekly rates. Furthermore, since the average hourly rates for all of the men are generally less than an average of the plant rates, the individual hourly rates are probably positively skewed.

Professor Frain also notes that the distributions of hourly plant rates are generally more peaked than the normal if the number of cases that fall within the limits of the standard deviation is taken as the measure of concentration. He finds that, for the distributions of the combined occupations for the years 1927 and 1929, the number of plant rates falling within the limits of the standard deviation are 71.4 and 74.4 per cent of the total number of rates. In a normal distribution, approximately 67 per cent of the rates would fall within these limits. While the proportion of cases falling within the limits of the standard deviation varies for the different occupations in the different years, the proportion is generally between 64 and 74 per cent.

Professor Florence[5] presents a table showing the average hourly earnings (arithmetic mean in cents) and the distribution of earnings per hour for 43,176 employees in eight typical occupations in American Saw Mills in 1925. The eight occupations with numbers of individuals represented are Sawyers (644), Edgermen (911), Setters (832), Trimmer Operators (600), Machine Feeders (planing mills) (1,535), Saw Tailers or Head Sawyers (786), Doggers (1,170), and Laborers (36,698). The order in which the occupations are listed ranks the occupations in accordance with their average hourly earnings. Sawyers had an average hourly earning of 87.7 cents, while laborers had an average hourly earning of only 30.9 cents. In all of the occupations except Sawyers, the dis-

[5] P. Sargant Florence, *op. cit.*, Table XVI B, p. 259.

tributions of hourly earnings show positive skewness. The most skillful occupation shows a large negative skew, the most prevalent hourly rate being 90 to 100 cents, while the arithmetic mean is only 87.7 cents. This evidence, taken collectively, seems to indicate the prevalence of skewness in hourly earnings, and an inspection of the distributions supports the general idea of a kurtosis greater than that of the normal curve.

Distributions of Price Relatives

Professor Frederick C. Mills has shown that distributions of price changes—regardless of whether they are relatives on a fixed or chain base, whether they are weighted or unweighted, or whether they are in natural or logarithmic form—depart from the normal distribution in both skewness and kurtosis. The sign of the skewness in these instances has some relationship to the sign of the mean change and corresponds to our findings with regard to distributions of numbers of concerns by changes in earnings ratios between successive years.

Distributions of Cost Data

Another type of economic series which has received considerable attention relates to the costs incurred by different concerns in producing the same or similar products. Professor Secrist[6] has presented arrays of total operating expenses per $100 of net sales for Retail Clothing Stores, in the years 1916 to 1920, inclusive. These stores were divided into five groups on the basis of the size of the cities in which they were located. The five groupings were: cities with population (1) under 10,000, (2) 10,000 to 20,000, (3) 20,000 to 40,000, (4) 40,000 to 120,000, and (5) 120,000 and over. There are arrays of expenses for each of the five years from 1916 to 1920, inclusive, and the average of these years. This gives a total of six arrays for each of the five population groupings. The

[6] Horace Secrist, *Competition in the Retail Distribution of Clothing*, Appendix I, p. 26.

arrays in the first population grouping show positive skewness in every instance. The arrays in the second, third, and fourth population groupings indicate negative skewness about as often as positive skewness, while the arrays in the fifth population grouping all show positive skewness. Professor Secrist, in summarizing the form of the yearly distributions for the entire 170 firms in the Retail Clothing Businesss without reference to the size of the cities in which they are located, points out that they are all positively skewed, but the skewness is small and he is of the opinion that the distributions are nearly normal.[7]

In connection with the data on earnings which were taken from the reports of the Federal Trade Commission,[8] it was possible, in a few instances, to secure cost data for these same concerns. The report on the Wheat Flour Milling Industry gave total costs for 101 concerns in dollars per barrel of flour produced in the year 1919, 105 concerns in the year 1920, 107 in 1921, and 102 in 1922. It was not possible, however, to identify the concerns having specific costs and earnings ratios. Individual cost and earnings ratios were presented for 22 Wheat Flour Mills for the period 1914 to 1922, inclusive, with the averages for this period.

The distributions for the larger samples of cost are presented in Appendix B, Table XV, with the arithmetic mean and median costs. In two of the four distributions the skewness is negative; the other two distributions show positive skewness. These distributions do not appear to show any great peakedness.

Since we could identify the earnings ratios and cost data for the 22 individual concerns milling wheat flour, it has been possible to compute coefficients of rank correlation between the ranking of the concerns by earnings ratios and their ranking by cost per barrel. Table 32 presents the coefficients obtained in this way.

These coefficients are all negative, but remarkably small.

[7] Horace Secrist, *Expense Levels in Retailing*, p. 4.

[8] See Table I, in Appendix B, for the references to these reports.

Some relationship, but not much, is shown between low unit costs and high earning power. The ranking of concerns by earnings ratios is not a very good gauge of their ranking by costs per unit of product produced. This fact is probably to be accounted for by the wide variety of wheat flour produced and sold. A high cost may mean a high grade flour which sells at a high price so that, since different concerns do not receive the same price per barrel, high cost need not mean low earnings ratios.

TABLE 32

CORRELATION BETWEEN RANK OF EARNINGS RATIO (HIGH TO LOW) AND RANK OF COST (HIGH TO LOW)

Industry	Years	Number of Concerns	Coefficients of Correlation
Southern Pine Lumber	1917	156	−.55
	1918	144	−.68
Wheat Flour Milling	1914	28	−.20
	1915	28	−.52
	1916	28	−.21
	1917	28	−.30
	1918	28	−.47
	1919	28	−.29
	1920	28	−.66
	1921	28	−.25
	1922	28	−.12
	Av. 1914–22	28	−.29
Petroleum (Pacific Coast Crude Production)	1918	134	−.84

Table XV, in Appendix B, also presents distributions of costs for the Crude Petroleum Industry in the years 1914 and 1915, and for the Southern Pine Lumber Industry in the years 1917 and 1918. The costs in the Petroleum Industry are average costs per barrel of output, while the costs in the Lumber Industry are average cost of sales per thousand feet of lumber. These distributions are all positively skewed, but the only material amount of skewness is in the costs of

Pacific Coast Crude Petroleum Production. Table 38 also presents the coefficients of rank correlation between costs and earnings ratios for these two bodies of data, since the cost and earnings ratio data could be determined for the same concerns. These two industries show higher correlation between costs and earnings ratios for the years covered by the data, but the correlation is not remarkably high in any case. It was also possible to secure the coefficient of rank correlation between the ranking of different firms in the Lumber Industry by the costs incurred in the two years. The coefficient secured, .62, indicates a slightly higher constancy in ranking by costs for this industry than in ranking by earnings ratios, since the coefficient of rank correlation between earnings ratios in these two years was only .56.

Mr. P. G. Wright,[9] in his analysis of costs in the sugar industry, presents cost data for Cane Mills in Hawaii, Cuba, and Porto Rico, and for Beet Sugar Mills. In all of these instances, differences in cost exist and the distributions are positively skewed. The variation in the cost of cane to the different mills is indicated by the fact that the highest cost is approximately twice as large as the lowest cost. The factory costs show that the highest cost mills have costs which are approximately three times as great as those of the lowest cost mills. Professor Taussig[10] has presented cost data on Beet Sugar for the year 1917, on Douglas Fir Lumber in Washington and Oregon for 1918, and on Bituminous Coal in southwestern Pennsylvania for 1917. The former two bodies of cost data are positively skewed, while the data on Bituminous Coal show a negative skew.

Public Utility Financial Ratios

In the series of bulletins[11] published by the Bureau of Business Research of the University of Illinois, a large variety of

[9] P. G. Wright, "Value Theories Applied to the Sugar Industry," *Quarterly Journal of Economics*, November, 1917, pp. 101–121.

[10] F. W. Taussig, "Price Fixing as Seen by a Price Fixer," *Quarterly Journal of Economics*, February, 1919.

[11] See p. 63, footnote 19 for the detailed references to these reports.

financial ratios for the Public Utility Industry is presented in frequency distribution form. Without discussing these bulletins in detail, it will be instructive to give a list of the ratios and the general characteristics of their frequency distributions. To accomplish this task with a minimum of space, the various ratios are listed in outline form, and their common characteristics are noted briefly.

I. Productivity Ratios

A. $\frac{\text{Gross Revenue}}{\text{Total Assets}}$

1. The frequency distribution of 1,479 ratios from 200 Public Utility Companies for the years 1915 to 1924, inclusive, shows material positive skewness. The approximate mode is 14 per cent. The lowest class interval (zero to three per cent) has fewer than four cases, while the highest class interval (48 to 51 per cent) has a frequency of one.
2. Distributions of these ratios when separated into geographical and size groups are of the same general type. When examined by years the same conclusions hold.

B. $\frac{\text{Gross Revenue}}{\text{Net Worth}}$

1. These ratios show same characteristics as A, above, but the approximate mode is 29 per cent.

II. Disposition of Income Ratios

A. $\frac{\text{Operating Expenses}}{\text{Gross Revenue}}$

1. The frequency distribution of these ratios for the 200 Public Utility Companies for the period 1915–24 is negatively skewed, with a

mode of approximately 72 per cent. The distribution is highly concentrated around the mode, while the range is from zero to 99 per cent.

2. The same characteristics are present for groupings which take into consideration size, geographical location, and years, but groupings by type of company show that holding companies do not have regular distributions.

B. $\frac{\text{Fixed Charges}}{\text{Gross Revenue}}$

1. The frequency distribution of these ratios for the entire sample in all years is positively skewed and has an approximate mode of 14 per cent.
2. Distributions by the more restricted classifications are of the same type, with holding companies as the exception.

C. $\frac{\text{Net Income}}{\text{Gross Revenue}}$

1. The composite distribution shows positive skewness, but the asymmetry is not so great as for the distributions in A and B, above. The approximate mode is 14 per cent.
2. The characteristics of the sub-divisions are the same.

III. Current Ratios

A. $\frac{\text{Current Assets}}{\text{Current Liabilities}}$

1. The composite distribution, shows large positive skewness with a mode of 61 per cent, and quartiles of 52, 92, and 162 per cent, respectively.

2. Sub-divisions of the data show the same general characteristics.

IV. Property Investment Ratios

A. $\frac{\text{Fixed Assets}}{\text{Total Assets}}$

1. The composite distribution shows large negative skewness, with a mode of 94 per cent and a range of from 60 to 98 per cent.
2. Divisions of the data show the same characteristics.

B. $\frac{\text{Investments}}{\text{Total Assets}}$

1. All distributions are J-shaped with tail to the right (1).

C. $\frac{\text{Current Assets}}{\text{Total Assets}}$

1. All distributions show large positive skewness. Approximate mode three per cent.

D. $\frac{\text{Other Assets}}{\text{Total Assets}}$

1. All distributions are J-shaped with tail to the right.

V. Sources of Capital Ratios

A. $\frac{\text{Long Term Debt}}{\text{Total Assets}}$

1. Most distributions show slight negative skewness, but are nearly symmetrical. The approximate mode is 48 per cent, while the range is from two to 79 per cent.

B. $\frac{\text{Current Liabilities}}{\text{Total Assets}}$

1. All distributions show large positive skewness, with approximate mode of three per cent and range of from zero to 36 per cent.

C. $\frac{\text{Capital Stock}}{\text{Total Assets}}$

1. The distributions show some positive skewness, but are nearly symmetrical. The mode is approximately 42 per cent and the range is from zero to 96 per cent.

D. $\frac{\text{Surplus \& Reserves}}{\text{Total Assets}}$

1. The distributions are all positively skewed, with mode of approximately seven per cent, and a range from -20 to $+45$ per cent.

E. $\frac{\text{Preferred Stock}}{\text{Total Assets}}$

1. The distributions are flat and nearly symmetrical, but tend toward positive skewness. Approximate mode 16 per cent, with range from zero to 40 per cent.

Summary of the Survey of Different Types of Economic Data

While this survey of economic data is extremely limited, it serves to show that distributions of such phenomena generally deviate from the normal distribution. Not all of the distributions show such radical departures from the normal curve as do the earnings ratio distributions, but in some aspect there is generally a difference between the empirical distributions and the normal distribution. An investigation of the various forms which the distributions of economic data take and of their relationships to each other would be extremely valuable, but such a task is beyond the scope of this study.

Our purpose has been served if we have been able to indicate the need for such a study and to show that earnings ratios are not the only type of measurable economic phenomenon that shows characteristics which differ from those which arise from a universe of symmetrically balanced forces. The writer believes that a careful investigation of cost data on the same scale as the earnings ratio data would show that cost distributions are generally more symmetrical than earnings ratio distributions and that in general they are leptokurtic, but that this characteristic would vary for different industries, as would also the sign of the skewness. Whether or not it would be possible to develop generalizations which distinguished the extractive, agricultural, and manufacturing industries cannot be predicted in advance because it is impossible to give definite characteristics to such broad categories.

The citation of evidence has now been completed, and we must attempt a summary of our findings. A summary of any empirical study is likely to raise more questions than it answers, and when our actual findings are recorded the reader may wonder if they warranted the work involved and the additional labor which must come later if the few generalizations suggested are to be more firmly established. With full recognition of these difficulties, we shall speak, in the following chapter, in as positive a tone as seems justified, so as to provide later investigators with some definite points of defense or attack, as the case may be. This attitude is adopted in the belief that undue caution may be quite as serious a defect as an excess of confidence!

CHAPTER VI

SUMMARY AND CONCLUSIONS

Before attempting to draw any conclusions from the data presented, in so far as profit theory is concerned, we shall summarize our findings in terms of earnings ratios only. After making this summary, and in the light of the obvious defects which the earnings ratios have as measures of profits, we may venture upon an interpretation in terms of profit theory. This procedure will present the material in its most positive form and separate the conjectural elements from the more positive findings.

Characteristics of Distributions of Earnings Ratios

Central Tendency

In the analysis itself we began with the measures of skewness, but the summary will develop more logically if we consider first the central tendency. Since the distributions are almost all positively skewed, we selected the median as the most representative measure from a practical point of view.[1] Our findings may be summarized as follows: (1) the frequency distributions do exhibit concentration around a central value, so that the idea of a central tendency has meaning empirically; (2) the medians of these distributions (246 in all) show a strong tendency to cluster within the limits of 10 to 12 per cent, even though the earning rates of the distributions from which they were drawn are not all computed on exactly the same basis; (3) where marked differences exist, they can generally be explained by certain unusual conditions which were present in the year represented by the distribution from which the unusual median was drawn, or by the difference which exists in the method of

[1] See pp. 153–160 for our analysis of the mode.

computing the individual earnings ratios; and (4) the earnings ratios below which 50 per cent of the assets fall are probably lower than the earnings ratios below which 50 per cent of the companies fall. The Public Utility Industry provides the exception to the last three of the points listed above, but in most of the other aspects of the distributions the Public Utility Industry is not an exception.[2]

In addition to the findings derived directly from the analysis of the most usual median value for all distributions irrespective of the industry or the element of time, we have corroborative evidence from analyses which introduce the element of time. When for data from the *Source Book of Industrial Profits* the median values of the 16 major industrial divisions are analyzed by years, we find that where the average of the 16 medians is exceptionally large or small, the individual medians do not show the same high degree of concentration (even in proportion to the higher average) as when their averages are close to the more usual average earnings ratios.[3] Furthermore, we found a tendency for the industries having median earning rates which are on the extremes in a certain year to revert toward the average median rate in the succeeding year, a tendency accentuated when the median earning rates in the first year are widely dispersed and the average of them is exceptional.[4] The same type of regressive relationship was true for the individual earnings ratios in a given industry.[5] This further evidence gives added emphasis to the contention that a central tendency does exist, although the effectiveness of this central tendency is counteracted by other factors making for permanent differences in earning power. The regressive tendency is not found in the Public Utilities.

A question that might well be asked at this point is this: if earnings ratios tend toward the central value between two

[2] For the detail of these findings and conclusion see pp. 121–131.
[3] See pp. 127–130.
[4] See pp. 179–180.
[5] See pp. 174–178.

successive years, why not find out whether, after several years, the earnings ratios actually attain the position toward which they tend? Such a question misses entirely the conditions which surround the data. If the conditions present in a given year were allowed to work themselves out and were not disturbed by other new conditions which develop in the course of time, such a result might be expected. When, however, we know that new conditions are arising continuously, the fact that the tendency toward a central value is never completely realized does not change the significance of the tendency. Furthermore, the mere fact that a few individual concerns, or a few industries, have a long history during which their earning rates are continuously above or below the average level is not a disproof of the leveling tendency if the entire body of data shows a net regression toward the mean. Such influences will, however, prevent the correlation between ranking in successive years from being large unless the individual influences can be segregated and treated separately.

The evidence of a central tendency which is similar for different industries and toward which individual concerns and industries regress is in need of further analysis, since some positive correlation exists between the successive yearly ranking by earnings ratios of concerns and industries.[6] This correlation is generally low except for Public Utilities, and, furthermore, the sizes of industrial median earnings ratios are positively correlated with the *amounts* of dispersion (but not with the coefficients of dispersion) for the different industries, and the ranking of industries by amount of dispersion is fairly constant between successive years.[7]

In addition to the general information presented above, the similarity of central position in the distributions for each industry is strikingly attested if the class interval frequencies for the 16 major industrial groups are added by like class intervals for all of the industries in all of the years. The resulting distribution will be clearly unimodal, but will have

[6] See pp. 173–176 and 179–181.
[7] See pp. 189–191.

large positive skewness. This alone would not necessarily indicate a common central earnings ratio for all industries, but, in the light of our other information about the size of the different distributions and the average of the yearly medians and their dispersion, it seems significant. It is true, of course, that if the industrial groups are broken down into smaller and smaller units the central earnings ratios will vary, since the limit of such divisions is the individual concerns which show marked differences in earning rates. On the other hand, with few exceptions, divisions of different industrial groups by size of concerns or location do not seem materially to modify the central earning rates if the split distributions are fairly large.

Skewnesss and Dispersion

By turning to the concepts of skewness and dispersion, we can add to the ideas developed above. The skewness of earnings ratio distributions is almost universally positive in sign and indicates that the distributions tail off in the direction of high earning rates and not low earning rates,[8] while the middle 50 per cent of the concerns fall within the limits of 10 to 15 per cent of the median value.[9] These findings are not materially affected by the elimination of extreme items from the distributions. On the whole, then, 50 per cent of the concerns in our samples of different industrial divisions make returns somewhere between 3 and 17 per cent of their investments, although, since the skewness is positive, the earnings ratios interval between the median and the lower quartile would be smaller than the earnings ratio interval between the median and the upper quartile. If, for the 80 distributions in the *Source Book of Industrial Profits* for the years 1924–28, we add all of the lower quartiles and divide by 80, we secure an average lower quartile of 6.9 per cent. The same process applied to the upper quartiles gives an average quartile of 18.0 per cent, so that the average inter-quartile range is 11.1

[8] See pp. 96–101.
[9] See pp. 131–139.

per cent. The average of the 80 medians is 11.8 per cent, so that the general positive skewness is attested, since $Md - Q_1$ is equal to 4.9 per cent, while $Q_3 - Md$ is equal to 6.2 per cent, and the Bowley measure of skewness would be +.12. This method of analysis also verifies our general findings about the position of the central tendency. Taking these averages as rough estimates and disregarding the time element, we know that, on the average, 25 per cent of the concerns in these samples make earning rates which are lower than 6.9 per cent and 25 per cent have earning rates which are greater than 18.0 per cent.

When the element of time is introduced we discover that the standard deviation or inter-quartile range *for a given industry* does not increase consistently with the changes in the mean or median earning rate for that industry,[10] nor does the absolute or relative amount of skewness increase with mean increases, or decrease with mean decreases.[11] The relative dispersions $\left(\frac{\sigma}{M} \text{ or } \frac{Q_3 - Q_1}{Md}\right)$ do, however, show that increases in the mean are generally accompanied by decreases in these measures.[12] The only positive interpretation of these findings must be largely empirical. The same industry does not show increases in the absolute measures of dispersion when the central earning rate is higher; and it must follow, therefore, that, as compared with the central value, the dispersion decreases with increases in the central value. On the other hand, *different industries* do differ in the amounts by which their earnings ratios are dispersed, and in general the industries with the larger dispersion have the higher median earning rates.

Kurtosis and Curve Type

In the analysis of the 53 distributions taken from Samples 1 and 2 before any extreme items had been eliminated, we

[10] See pp. 182–188.
[11] See pp. 167–173.
[12] See pp. 185–188.

discover that all distributions except one are more peaked than the normal (i.e., leptokurtic), and this one exception is really the result of heterogeneity in the data.[13] After extreme items have been eliminated, 10 distributions are less peaked than the normal, but the majority of the distributions are still leptokurtic.[14] The variety of curve types which are derived, however, convinces us that the kurtosis characteristic was not extremely meaningful for earnings ratio analysis, since the persistent presence of positive skewness and extreme items is bound to mean that the fourth moment will be large when compared with the second moment squared.

It may be stated, in general, that our curve type analysis was not very productive of specific conclusions. We did learn that, although our distributions have certain common characteristics, they are not describable by any one Pearsonian curve type, and that in general they contain elements which give curve types that are not the result of stable causal factors like those underlying the normal or Type III curves.[15] When extreme items were eliminated, we noted a tendency for the distributions to approach the Type III curve, but even then a large number of the distributions were quite far removed from Type III.[16] Practically all of these conclusions could have been derived from analyses that did not involve the development of Pearsonian curve types, but the effort was not entirely without results, since it aided in giving some insight into the characteristics of the causal universe from which the earnings ratios in our samples were drawn.

Probably the most illuminating part of our curve type analysis develops from a comparison of the distributions based upon the original earnings ratios and those constructed from the changes in those ratios between successive years.[17] If the former distributions gave curves with little stability, the latter distributions give curves with even less stability.

[13] See p. 152.
[14] See Table VIII, Appendix B, and discussion on p. 163.
[15] See pp. 147–153.
[16] See pp. 162–165.
[17] See pp. 200–207.

In general, the distributions based upon changes in earnings ratios were skewed in the direction of the mean change. The mean change was generally small and the modal change even smaller, but the dispersion as measured by the standard deviation, or the inter-quartile range, was very large. These indications are in direct line with previous interpretations, and show that the common characteristics of successive distributions of earnings ratios are based upon changes internal to the distributions which allow some concerns variations within wide limits, while the bulk of the concerns show practically no change in earnings ratios. In the light of these findings, it is not surprising that earnings ratio distributions are not describable by curves which are intrinsically stable, and it is rather remarkable that the distributions show as many persistent traits as our analysis indicates.

This chapter has thus far been devoted to a review and summary of certain findings and interpretations which were advanced in Chapters III and IV. The summary has been stated in terms of earnings ratios, and no attempt has been made to express it in terms of profit theory. We are now in a position to review these general summarized conclusions, and to see whether they hold any meaning for the theoretical implications involved in the economist's analysis of profits.

General Summary and Interpretation of the Characteristics of Earnings Ratio Distributions

Before we begin to interpret our data as they may relate to profit theory, it seems advisable to gather together our findings and present them in their most generalized form. Distributions of earnings ratios for different industries or major industrial groups seem to have a common central earnings ratio. These distributions are asymmetrical and show a preponderance of positive skewness. This asymmetry and positive skewness is not entirely the result of mechanical features in the composition of our data,[18] nor does it result from the presence of extreme items. The variation of the earnings

[18] See pp. 101–121.

ratios for a given industry or major industrial group seems large, but this variation or dispersion, as it is called, must be interpreted in the light of our findings with regard to the kurtosis or peakedness of the distributions. With but few exceptions, even after the elimination of extreme items, most of the distributions are more peaked than the normal distribution, so that, speaking in relative terms, the variability or dispersion is not large[19] when conceived of as a ratio between the sum of the fourth powers of the deviations from the mean and the second power of the sum of the squares of these deviations, which is σ^4, since σ, which is the measure of dispersion, is equal to $\sqrt{\nu_2}$ where ν_2 is the sum of the squared deviations from the mean divided by the number of frequencies. In nontechnical language, this means merely that in terms of the range of the earnings ratios there is a relatively large amount of concentration around the central value. The attempt to characterize the distributions in terms of Pearsonian curve types was instructive to the extent that it enabled us to discover that, although almost all of our distributions are positively skewed and more peaked than the normal curve, no one curve type suffices to describe them, and in most cases the distributions seem to be of an unstable order.

When our successive distributions are analyzed so as to include the element of time, we discover that the direction of change in the mean is not associated with the direction of change in skewness, dispersion, or kurtosis. We conclude from these general findings that causal factors influencing the variations about the central value are not perfectly connected with the causal factors which generate the central tendency. In brief, our hypothesis is that the forces making for a central tendency are constant forces, but that these forces are continually being disturbed or interfered with by the introduction of unpredictable elementary causes which modify the character of the complex of causes present at any one time. The net result of these conditions is distributions

[19] By "not large" we mean not large when compared with the normal distribution.

which are intrinsically unstable and which prevent changes in the central measure from being a good index of the character of the shifts in the causal universe which bring about the earnings of the different concerns in an industry. The tendency of all of the industries towards a similar central earning rate seems to indicate that the permanent set of causes which generate the central tendency is common to all industries. The constancy of *different* amounts of dispersion for the different industries or major industrial groups suggests that, to some extent, there are permanent differences in the entire set of causes which govern the earnings ratios of the concerns in different industries.

Combining these findings with those derived from the study of the permanence of the position of individual concerns within the successive yearly distributions, we secure further support for our conjectures. Some forces make for permanence of ranking, since the correlation between rankings in successive years is small but persistently positive. On the other hand, when we correlate the earnings ratios in a given year with the amount of change in these ratios by the succeeding year, the correlation, while not large, is persistently negative. There are forces of some permanence connected with individual concerns, but these concerns are, nevertheless, subject to more general causal factors which tend to cause a regression toward the mean and give to the central values of the entire distribution of earnings ratios a definite significance as a central tendency. When these results are not true for Public Utilities (where the competitive elements are known to be less pronounced), a rather substantial body of facts seems to point in the same general direction and give assurance that our hypotheses are reasonable ones. The analysis of distributions based upon changes in earnings ratios between successive years shows that the individual changes are skewed in the direction of the mean of the changes, that a majority of the changes are of small magnitude although the range over which the entire body of changes takes place is very large, and that these distributions

are very unstable. When these findings are included we derive further support for our generalizations, since the permanence of the rankings of the individual concerns in successive years can be partially accounted for by the large number of concerns which show only very small changes in earning rates, while the regressive tendency is largely the result of the movements on the extremes. The wide spread of the changes and the instability of the distributions give additional support to the idea that the causal universe is being continuously disturbed by the introduction of new and unpredictable factors which disrupt but do not destroy the cohesive factors making for a central tendency in the distributions of earnings ratios in each year.

A similar study of rankings by median earning rates in successive years for the 16 major industrial groups gives similar results. Some factors are present which tend to give industries a permanent rank by average earnings ratios, but there is also a persistent tendency to regress toward the mean, and this tendency is stronger when the industries are disturbed from their usual positions and the general collective average earning rates are exceptionally high or low. Furthermore, the different industrial groups exhibit a strong tendency to permanent difference by amount of dispersion, and this difference in dispersion is positively correlated with the permanence of high or low median earning rates, thus suggesting that the permanence of differences in median earning rates is related to factors which make for differences in dispersion.

Implications for Profit Theory

Introductory Remarks

In Chapter I an attempt was made to explain the concept of profits as it has been developed within the general body of the competitive equilibrium analysis. Our general conclusion was that the concept of profits differs from the concept of other income shares, since the share called profits does not exist under equilibrium conditions. The presence of profits in the world of reality must, then, indicate the absence of per-

fect competition. We were careful to point out that perfect competition in time involves the absence of unpredictable events, but not the absence of risk. In a recent article William S. Hopkins reviews the development of the concept of profit in American economic theory, and points out that this development was one of successive refinement. He says:

> The start is taken from the classical definition of profit, as exemplified by John Stuart Mill. According to his definition, which was widely accepted in the United States prior to 1883, profits is composed of interest, wages of management, and the reward for risk-bearing. In three successive stages, American theorizing has rejected each of these component parts, leaving no content whatever to the old definitions.[20]

Without entering into the history of the development, we indicated in Chapter I the general logic which impelled the change. The question now before us has to do with the suitability of our data for profit theory analysis. The most logical preliminary point of attack is to present our data with the concept of profit in mind and see whether they meet the necessary conditions.

In Chapter I we noted that one general concept which is often used to distinguish profits from other income shares is to describe them as residuals in the sense that no contractual obligation exists as regards their payment. Stockholders, partners, and individual proprietors are in a position to receive such windfalls and are often thought of as the principal recipients of profits. Under this interpretation, that part of the earnings which is left over after the payment of all contractual obligations represents the earnings of the owners of the business. If from these earnings we substract interest (an amount considered to be a "normal" payment for savings) and wages of management (payments that are necessary if the management is to continue, but for which no contractual agreement exists), the residue is thought of as profits and may be negative or positive. The difficulties with this con-

[20] William S. Hopkins, "Profit in American Economic Theory," *The Review of Economic Studies*, p. 60, October, 1933.

cept of profits as a practical tool arise from the differences in the financial structure of different concerns. If only a small part of the capital structure is furnished by stockholders, while a major part is furnished by bondholders, then, although the earnings of the business on the entire investment before interest payments may be only 10 per cent, the payment of five per cent as a contractual payment on bonds would mean that the stockholders receive a much larger percentage return than 10 per cent.

The extent of this possibility is strikingly illustrated by a simple hypothetical example. Assume a business enterprise to be organized with a total investment of $1000. Let $900 of this investment be represented by bonds paying interest at the rate of five per cent. The $100 of the stockholders' investment would—if the rate of earnings on the total investment is 10 per cent—earn a rate of 55 per cent, since all earnings greater than five per cent of $900 (i.e., $45) would constitute the equities of the stockholders. If we had assumed that five per cent was the normal interest rate, then the profit of the enterprise would have been five per cent, but, on account of the financial structure, the stockholders would have earned 55 per cent, or an excess over the assumed normal interest rate of 50 per cent. If the stockholders' investment is assumed to become a larger and larger percentage of the total investment, then the estimate of the excess of earnings over estimated normal interest approaches five per cent as a limit.

If, therefore, we are desirous of comparing rates of profits for different concerns or different industries, it is difficult to tell whether inequalities which arise are the result of differences in operating earning power or of differences in financial structure unless the investment base used eliminates these difficulties. As a result of such considerations, we concluded that the best measure of earning power must rest upon an investment base which includes both stockholders' and bondholders' investments (i.e., net worth) corrected for outside investments and asset values (such as good will) which repre-

sent capitalized earnings. As the best measure of earnings to use, we selected net earnings before the payment of interest on long-term debt or taxes, less income from outside investments. The difficulties in securing such ideal ratios were made clear by pointing out that such ratios would be ideal only under the assumption that the investments so obtained really represented the original investments and were not inflated or deflated by the numerous organizing and operating practices of business enterprises, and that the costs subtracted from gross earnings to get net earnings were the true competitive costs so that officers' salaries, depreciation items, etc., were not used to hide the true net earnings.

We then recognized that our data on earnings ratios were far from ideal, but for the most part, approximations to the ideal measures of earning power. With all of these points to be constantly borne in mind for every interpretation, what implications do our findings offer for profit theory?

Industrial Median Earning Rates and Profit Theory

In interpreting our findings with regard to central tendency we were careful to point out that, because of certain imperfections in the data, the significance of the absolute values of the median earnings ratios could not be interpreted positively, and at that point we stated our conclusions in such a manner as to exclude this element. The conclusions as stated had, even under these conditions, certain rather valuable implications for profit theory. In line with the competitive analysis, we found that even though the different bodies of data were not perfectly comparable, the different industries did seem to tend toward similar earning power when the median earnings ratios were compared, and, furthermore, a regressive tendency was disclosed when the rankings of the different major industrial groups in successive years were correlated. We must now attempt to evaluate the factors which prevent a positive interpretation of these measures of average earning power as absolute values and to make some estimate of their significance.

In general, we discovered that the most usual median earnings ratios for all industries fall within the limits of 10 to 12 per cent. If then, we select 11 per cent as the figure most representative of the average earning power of collective industry, does this figure indicate profits which are high or low? Before attempting to estimate what proportion of such an earning rate is truly profit, we should try to evaluate the various factors that may have prevented the earning rate itself from being an accurate measure of the true earnings. For instance, it may be that our median earnings ratios for the different industries have been made unduly low by the high salaries paid to the executives of the different concerns in the industry. The writer believes that for the bulk of the material this is not the case. Professor Nerlove has shown[21] that, in general, officers' salaries, for industry as a whole, are about three per cent of invested capital and that this percentage does not vary greatly from year to year. This factor was also considered more specifically in certain studies of the Federal Trade Commission. For instance, the commission found that the Stove Manufacturing Industry, as a whole, paid officers' salaries which were only 2.7 per cent of the average investment in 1920 and 2.5 per cent of the average investment in 1921.[22] Similarly, for 299 Furniture Manufacturers, it found officers' salaries in 1920 were 6.6 per cent of the investment and in 1921 they were 4.7 per cent. For 355 Furniture Stores, it found that salaries in 1920 were 6.8 per cent of the investment and in 1921 they were 5.7 per cent.[23] These findings of the Federal Trade Commission were in industries where the bulk of the concerns were owned largely by the officers of those concerns, and it was discovered further that the percentage of salaries to investments was generally larger for small concerns than for large concerns. These findings seem to indicate that no very serious

[21] S. H. Nerlove, *A Decade of Corporate Incomes, 1920–1929*, p. 47, Table XV.

[22] Federal Trade Commission, *Report on House Furnishings Industries*, Vol. II, Tables 18 and 19, pp. 48–49.

[23] Federal Trade Commission, *Report on House Furnishings Industries*, Vol. I, Table 14, p. 69, and Table 27, p. 100.

errors have been introduced in our analysis of earning power by high salaries paid to executives. The percentage of total salaries to investment is generally below six per cent, so that even if salaries were twice as high as they should have been under competitive conditions, our earnings ratios would be increased by only from one to three per cent. The reader should remember, of course, those instances where large salaries have been paid to executives, for we have no thought of suggesting that no profits are hidden in this way. But if we consider the concerns with which such salaries are associated, it will be clearly evident that, although the absolute figures for the salaries may run into millions of dollars, such figures constitute but a very small percentage of the investments of those concerns and salary items would not materially affect the earnings ratios which we are discussing.

The various reorganizations, depreciation practices, etc., of the individual concerns in every industry must not be ignored, but here again the changes which a more nearly accurate—or, perhaps better, a more strictly comparable—set of practices would make in our conclusions would hardly be material. The type of analysis which we have attempted here was not designed to develop findings with regard to individual concerns, but it was intended, rather, that when the analysis was completed we should be able to point out certain group characteristics which, although they were not descriptive of all of the conditions affecting earnings ratios, would describe those larger forces which affect and influence the earning power of the bulk of industrial endeavors.

On the other hand, we noted that our samples had an upward bias, since they include only those concerns which survived during the years covered by the samples. The concerns which failed and the new concerns are not included. Concerns which were reorganized and whose capital structure was subjected to change were not excluded, so that some cases of this sort are probably present. It is clear, then, that the average earning rates derived from the different industrial samples are not necessarily descriptive of the earnings

of an industry as a whole, since part of the industry is excluded. The failing concerns probably have earnings ratios which are negative and further removed from the median than are the positive earnings ratios of the new concerns, since the new concerns require some time to adjust themselves to the industry and to make their economies of organization effective. As a result a more complete sample would tend to lower the central earnings ratios rather than to raise them.

Furthermore, we have some evidence which indicates that the median earnings ratio below which 50 per cent of the assets fall is lower than the earnings ratio below which 50 per cent of the companies fall, so that if our inquiry into the most probable earnings ratios is based upon asset distributions, the figures 10 to 12 per cent are again biased in an upward direction. Since the distributions are almost all positively skewed, the mode would be lower than the median and would be the more appropriate measure of the most probable earnings ratios. The further fact that taxes were not excluded from the net earnings gives added support to the opinion that there are elements of upward bias in the distributions which are at least equal to the downward bias.

When all of these factors are taken into consideration, the probability is that the figures 10 to 12 per cent, as representative average earning rates for industry as a whole, are too high rather than too low. When the amount of such earning rates which represents profits is considered, the question of estimating the "normal" or necessary interest payments comes to the fore. Should the interest rate used represent merely the payment for saving with the yield of (say) British Consols or United States government bonds accepted as the proper rate, or should the yield on high-grade industrial bonds be chosen as the basis for the proper interest rate? On the whole, the writer believes that the interest rate should include an average payment for risk and that the yield on high-grade commercial bonds would probably be the more appropriate interest rate to use.

The yield on such bonds from 1920 to 1929 ranged between four and five per cent, and Federal income taxes ranged between one to two per cent of investment, so that, after deduction of the probable interest and tax payments, the rate earned by industry would probably be somewhere in the neighborhood of five or six per cent. About 50 per cent of the concerns, and more than 50 per cent of industrial investments, would make less than these percentages of earnings over interest and tax allowances. If these estimates are accepted and consideration is given to the probable upward bias in our samples and to the fact that the modal earnings ratios are lower than the median earnings ratios, it would then be true that industries as a whole make only small profits. To be as specific as possible, since the medians for the asset distributions are lower than the medians for the distributions of number of concerns and both types of distributions are positively skewed, the modes of the asset distributions are lower than the modes of the distributions of the number of concerns. While 50 per cent of the concerns have *profit* ratios greater than five or six per cent, the modal earnings ratios will be less than five or six per cent for the distributions of the number of concerns and the modes for the asset distributions will be still lower and will probably approximate a maximum of three or four per cent. Many concerns do make profits, and many types of owners in these concerns make profits which are extraordinarily large; but in the writer's opinion, there seems to be a central tendency among earnings ratios which eliminates large profits for an industry as a whole. This opinion must not be interpreted as carrying with it an endorsement of a competitive economy, or what is left of such an economy, since it means merely that the writer finds in our present economy enough competitive forces to exert a central pull in the direction indicated in the competitive analysis—that is toward the elimination of profits for an industry as a whole.

If this opinion is accepted, the theory of profits must explain how the complex of forces present in economic reality

brings about variations of earnings such that, in spite of this central tendency, profits which are negative or positive always exist for some concerns but for industry as a whole profits seem to be restricted to small amounts. Under these conditions profit theory must explain how individual concerns incur profits and losses of varying amounts, and it must explain, further, how industrial enterprise as a whole always makes some degree of profit or loss. The remainder of this chapter will be devoted almost exclusively to the first of these points. Before we enter upon this explanation, however, it seems advisable to point out once more that our analysis of profits is in terms of total investments which are subjected to the play of the economic forces of reality. The analysis does not distinguish between, nor constitute an evaluation of, those conditions of supply and demand which determine the extent to which the different types of owners have claims upon the earnings of the business.

Earnings Ratio Distributions and Profit Theory

The reader will probably remember that we adopted the frequency distribution type of analysis because this type seemed most likely to give us an insight into the character of the causes which determine earnings ratios and indirectly determine profits. Professor Pigou presents some interesting comments on the use of a frequency distribution for the analysis of the nature of uncertainty-bearing. Without quoting directly, we take the liberty of using a part of his argument to point up the results of the present study.[24] He states that the principal species of schemes which are likely to occur when a certain investment is subject to various types of uncertainty can be classified as follows: (1) the prospective returns under review may be distributed symmetrically or asymmetrically, (2) the symmetrical distributions may be divided into curves which spread out like an open umbrella and curves which are narrow like closed umbrellas, and (3) the asymmetrical curves may be divided into curves which

[24] A. C. Pigou, *The Economics of Welfare*, third edition, Appendix I, pp. 769–779.

tail off to the right (are positively skewed) and curves which tail off to the left (are negatively skewed).

The earnings ratio distributions which we have analyzed belong to the asymmetrical species in which the skewness is positive. Furthermore, these curves are like closed umbrellas, but the right side is pulled out of shape so that the range on the right side of the most probable return is larger than the range on the left side of the most probable return. In a symmetrical distribution of returns, it is clear that if r represents the actual value of an investment exposed to any scheme, the chance of obtaining a return $(r-h)$ is equal to the chance of obtaining a return $(r+h)$ for all values of h. The asymmetrical group includes all other schemes, and the type of asymmetry exhibited by earnings ratio distributions is such that the chance of getting a return of $(r-h)$ is less than the chance of getting a return of $(r+h)$. It is also obvious that a symmetrical scheme can arise only when $-h$ can be as large as $+h$.

In a previous analysis[25] we have already explained that, since our distributions are made up of ratios, the extent of a loss can not be greater than 100 per cent, but a gain is not so limited. This statement is not strictly true, for a partnership or individual proprietorship might suffer losses greater than the total investment involved, and even corporations might do so under certain conditions. Neglecting these possible exceptions, however, we argued that we did not believe that the limits based upon the fact that we were using ratios explained the extent of the skewness which the earnings ratio distributions exhibited. How, then, do we explain the characteristics exhibited by the distributions?

On the side of losses, or very low returns, the resistance set up must be much greater than on the side of large gains. Plants may be closed in whole or in part, employees may be laid off and their salaries reduced without causing their immediate withdrawal, and in some instances the actual investment values may be reduced by reorganizations. Restrictions exist

[25] See p. 101.

on the other side, also, but they are not forced into operation so soon or so effectively, since no incentive exists on the part of the active management to bring them into effect. Under these conditions, the play of forces which account for the distributions is more sensitive to movements in one direction than to movements in the other.

The position of the central tendency and the concentration around it seem to be the result of forces which are always present and which serve to give a cohesion to the play of forces which is similar to the force exerted by the characteristics of a penny which approximates a homogeneous disk and which (although subject to numerous unpredictable forces) when tossed in the air will fall heads-up about as often as it falls tails-up. In contrast to these constant forces, however, there seem to be some which change the nature of the causal universe, and the change might be thought of as being similar to a change in the character of a penny which makes it heavier on one side than on the other and is therefore more likely to be effective in one direction than the other. Or we might think of the constant forces being continuously shifted into a new environment where a greater bias exists in one direction than in the other.

A study of the internal elements in the distributions seems to give support to these generalizations, for the various concerns shift about and the distributions of either the earnings ratios or their changes are not describable by curves which are generated by a stable set of causal factors. These forces which change the constituent elements in the causal universe may be thought of as changes unpredictable in nature, but against which unequal resistances come into play, so that they have more force in one direction than in the other.

The fact that the distributions are more peaked than the normal, and that shifts in the central value are not correlated positively with changes in the character of the variation around such a value, gives support to this interpretation of duality in the causes generating the distributions. While some concerns and industries tend to maintain their respec-

tive positions in successive distributions, there is a sufficient number of concerns which do not maintain their ranking to allow a regressive tendency toward the mean to appear when we study the changes in earnings ratios between successive years in relation to the earnings ratios in the first year; and this fact indicates that, while some concerns can, for a time, get outside the pull of the cohesive forces, a large number cannot do so.

Furthermore, the relationship between the amount of dispersion and the permanence of the rankings of different industries by median earning rates seems to indicate that the extent to which the concerns in different industries can get outside the pull of central forces is greater in some instances than in others, and that these possibilities are more often realized in the direction of high profits or in the elimination of large losses, so that the median position is pulled to the right when the spread of the middle 50 per cent of the earnings ratios is large.

Specific Profit-Making Factors

With these generalizations in mind, we may make our conclusions more specific by analyzing these generalizations in the light of the profit-making factors suggested in a previous outline.[26] Under the first general division of that outline, we attempted to account for differences in net earnings ratios among the individual concerns in the same industry. The factors which seem most reasonable from the standpoint of our analysis are those which, as a result of unpredictable changes, give specific advantages to certain individual concerns. Such factors as (1) the advantages of plant construction and operating efficiency which arise as a result of the time at which the business is organized or experiences its major development, and (2) the advantages which arise from the character of the product and allow the attachment of customers through trade means and other devices, are examples in point. Such factors as the special ability of certain manage-

[26] See pp. 18–20.

ments do not seem to be given much support by our data since the positions of the concerns shift so materially. Probably there are some instances in which a given concern has maintained a high ranking in successive years with no other apparent cause than exceptional management, as exceptional management is defined in point 2 under the first main division, part A of the outline on page 18. However, after noting the names of the corporations on the high earnings extremes in Mr. Sloan's study,[27] and calculating the correlation between cost and earnings discussed in Chapter V, the writer believes that the factors referred to above as factors (1) and (2) are chiefly responsible for the differences in net earnings ratios among individual concerns in the same industry. The factors accounting for the difference in average earnings ratios among industries are again expressed largely in terms of the character of the industry, in so far as these characteristics give the concerns within the industry a better opportunity to remove themselves from the competitive pulls. Our data do not cover a sufficiently long period nor allow sufficiently careful divisions into industries to enable us to study the rise and decline of different industries, nor is our material sufficiently complete to permit of any significant discussion of the influence of the business cycle.

General Conclusions

Our analysis has shown that the median earning rates for the different industries have a tendency to approximate 10 to 12 per cent. If, after considering the various elements affecting our earnings ratios, we subtract federal taxes and allow an approximate interest rate on the investment, the median earnings ratios would be under five per cent. Since about 50 per cent of the concerns in the middle of the distributions of earnings ratios have earning rates within the limits of 7 to 18 per cent—with 25 per cent having earning rates less than seven per cent, and 25 per cent having earning rates greater than 18 per cent—profits for an industry really

[27] See reference p. 74.

mean profits for about 50 per cent of the concerns in the industry, and only about 25 per cent of these concerns make profits of significant size. It might seem, then, that a theory of profits could arise from a study of those concerns which have earnings ratios above 18 per cent. Our analyses have shown, however, that the same concerns are not present within this group of profit-earners from year to year, so that the isolation of the factors influencing profits is much more difficult. Forces seem to be present in industrial society which would eliminate profits for all concerns, but within this same society new factors continuously intervene, and the result is that about 50 per cent of the concerns show profits, while 25 per cent have profits which are significantly large, but the same concerns, with some few exceptions, are not inhabitants of the profit region continuously.

These facts lend little support to the idea that profits accrue as a result of differential business ability, since, with some few exceptions, the same concerns are not always profit-earners. Furthermore, it does not seem to be the riskiness of business which leads to profits so much as it is the uncertainty of business life, which, taking business concerns as a whole, bestows its gifts now upon one group and again upon a substantially different group. We are not, of course, attempting to outline a complete theory of profits, since such an undertaking would have to be based upon a well coördinated analysis of the entire economic system. We are suggesting, however, certain interpretations which such a theory of profits would have to take into consideration if it were to be at all descriptive of economic reality.

Our conclusions in general are as follows: (1) competitive factors prevail within the different industrial groups to such an extent as to make for a common representative average earnings ratio for all industries, and when this earnings ratio is analyzed and an estimate made of all relevant factors it does not seem to contain any large element of profits; (2) the disparity among earnings ratios for the different concerns in the several industries exhibits the effect of common causal

elements making for uniformity in earning power, but this disparity is never eliminated because *a succession of modifications* in the total causal universe takes place in such manner as to breed a new disparity; and (3) the most satisfactory explanation of these conditions appears to be that certain concerns gain a place outside of the immediate influence of competition through the control of demand or through the advantages of technical developments.

Some of these conclusions may seem directly to contradict the common observations of everyday life. Every reader will be able to point to successful corporations whose continuous success is a matter of historical record. But such observations do not really invalidate our interpretation. There are, and probably will always be, notable examples of this sort, but, as industry is now organized, the causal universe from which profits arise, while exhibiting central tendencies somewhat in line with the assumptions of the competitive economy, exhibits also causal factors which lead to a wide variety of earnings ratios. These factors seem to warrant the statement that the profit-making concerns in any one year make profits because of developments favorable to them, and that, while a few concerns may win a place beyond the reach of the forces which control the central tendencies, the bulk of the concerns do not do so.

APPENDIX A

APPPENDIX A

I. Federal Trade Commission Data: Methods of Calculating Earnings Ratios

Shoe Manufacturing Industry

The data for 1914 to 1917, inclusive, are taken from the *Report on Leather and Shoe Industries* by the Federal Trade Commission. This report was presented to the Senate on August 21, 1919. The Commission describes the data on investment and earnings as follows:

> Satisfactory data for investment and earnings were obtained from 237 manufacturers. From these statements returns of earnings on investment have been computed. The investment is net. To find the net investment the values ascribed to good will, trade-marks, and patents, the amounts invested in other enterprises or other corporations, the current liabilities and certain reserves were added together, and the sum of these amounts was deducted from the total assets. In a very few cases it was impossible to separate the outside investments as they were not shown in sufficient detail to make the segregation. In every case these outside investments were comparatively small. The current liabilities deducted were all of the accounts and bills payable. The usual deduction for reserves was the reserve for depreciation. In some instances the balance sheet showed an item of loans from stockholders. These loans have been treated as other bills payable, except where they were for long terms, and they are included in the deductions. In a few cases the deduction of such loans left a comparatively small amount for net assets, but the rule here described was adhered to in every instance.
>
> The earnings shown are those derived from manufacturing and selling shoes, but as just noted, there were a few instances in which outside investments could not be determined, and in these cases the incomes from such investments were allowed to remain in the earnings. The instances in which these sepa-

> rations could not be made, however, were but few. All interest and Federal taxes that had been deducted by the companies before making up their income statement were put back with earnings wherever it was possible to determine the amounts of these items. In many cases, however, in the years prior to 1917 it was not possible to determine whether or not Federal taxes were included in earnings, and the accounts had to be accepted as shown by the statements submitted by the companies. The Federal taxes in these years, however, were comparatively small, and did not seriously affect the rates on investment. Wherever the earnings shown in the table vary from exact earnings, they are always smaller than the inclusion of Federal taxes would have made them. The accounts of some corporations disclosed a practice of crediting the loss and gain account with trade discounts taken on the invoices for materials and supplies. This treatment of these discounts sometimes resulted in showing a loss in manufacturing and selling, but in the final statement of the companies it resulted in a profit. All such discounts were treated as earnings (pp. 99–100).

Data for the year 1919 are obtained from a continuation of the study of Leather and Shoe Industries published by the Federal Trade Commission on June 10, 1921, and entitled *Report of the Federal Trade Commission on Shoe and Leather Costs and Prices*. The table from which the data in this study are taken is in the appendix on pages 207 to 211, inclusive, and is numbered 36.

With reference to the data on the relationship between investment and profits the Commission states the following rules:

> . . . Of the 1,085 companies to which schedules were sent, the returns of 341 were available for presentation of manufacturers' investment and earnings in the production and sale of shoes. The total production of these 341 companies in 1919 was 202,970,829 pairs, representing about 62 per cent of the total production indicated in the census of 1919.
>
> In arriving at a total investment the Commission has included the following items: Capital stock, bonds, and other long-term debts; surplus as reported by the company; all items

of appropriated surplus, such as reserves for income and excess profits taxes, discounts, bad debts, etc.; and the average of current borrowings as shown for the first day of each month. Reserves which were not appropriations of surplus, such as depreciation on buildings, machinery, etc., were not included. From the sum of the foregoing items were deducted such assets as are attributed to good will, patent rights, trade-marks, etc., together with the sum of all investment in property not used in the manufacture of shoes (such as stocks and bonds of other companies, Liberty bonds, real estate, treasury stock, etc.).

Manufacturers' profits as represented in this section were arrived at by eliminating from the manufacturing and income statements all items not incident to the manufacture and sale of shoes. In a few instances it was not possible to segregate all of these items but such of them as have been included are relatively too small to have any important effect upon the rates of profit. Profits are shown both before and after deduction of interest on borrowed money but in neither case have deductions of income and excess profits taxes been made. The profit shown before deduction of interest is the profit properly applicable to total capital employed (total investment), while the net profit after deduction of interest is the return on net worth or shareholders' capital as represented by capital stock and surplus.

Profit before deduction of interest is the difference between total sales and the sum of operating expenses, net discounts, and "other income and deductions" (such as bad debts, donations, etc.). Owing to the importance of discounts in the shoe industry and the fact that they are too large to be merely cash premiums it was necessary to apply them against profits. And since the discounts are not always taken or given they could not properly be shown as deductions from sales or cost of product sold (pp. 97–98).

Tanning Industry

The data for 1914 to 1917, inclusive, are taken from the 1919 report noted above. The Commission describes the data on investment and earnings as follows:

All of the tanners of the United States were requested to furnish balance sheets for the years 1914, 1915 and 1916. In connection with the work for the War Industries Board, balance sheets for 1917 were secured from a large number of concerns whose costs were ascertained. Altogether there were found to be 53 companies whose balance sheets and profit and loss statements were in such form as to enable a tabulation to be made showing the net investment and the net earnings from operations.

The statements submitted by the companies for the years 1914, 1915 and 1916, were sometimes not in such detail as were those which were secured by the accountants of the Commission covering the year 1917. In connection with profit and loss it was not possible to determine in many cases from the statements supplied by the companies whether the net earnings was a figure representing the earnings of the business before of after the payment of interest and Federal taxes. In most cases it would seem that Federal taxes and interest had been deducted in the income statements. For the year 1917 these items were usually shown separately, and where they had been deducted they were put back into earnings. The item of Federal taxes was much smaller in the years prior to 1917 than in 1917, and the exclusion of that item from net income does not so seriously affect the results of their statements as it would have done to have excluded them from 1917. . . .

It is a safe assumption that the 53 companies represented in the foregoing table are a fair index to the general conditions in the tanning business. The table includes a number of very small companies, a number of large ones, and a considerable number of what may be considered average concerns (pp. 26–27).

The Commission's remarks (p. 165) on accounting methods of the tanners must be considered in interpreting the data.

The data for 1919 are taken from the 1921 report noted above. In reference to these data the Commission reports as follows:

In arriving at the profits shown above all items not incident to the tanning and sale of shoe leather were eliminated from

the manufacturing and income statements. In a few instances it was not possible to segregate all of these items, but such inclusions were relatively too small to have any important effect on the rates of profit. The net profit shown was arrived at by deducting from total sales the total cost of product sold, the net of discounts given and received, and the net of sundry items of income and expense, including bad debts charged off and donations. The treatment of discounts in this manner was determined upon because of the fact that in the tanning industry discounts are so large as to be more than mere cash premiums, but since they are not always taken may not be treated as trade discounts deductible from sales or purchases.

The profits shown were those earned on shoe leathers. No deductions were made for interest on borrowed money or for income and excess profits taxes. It was not possible to ascertain the amount of these items to be allocated to sales of shoe leathers (p. 78).

. . . . . .

In arriving at a total investment for tanners the following items were included: Capital stock; bonds and other long-term debts; surplus as reported by the company, adjusted for revision of inventories; all items of appropriated surplus, such as reserves for income and excess profits taxes, discounts, bad debts, etc.; and the average of current borrowings as shown for the first day of each month. Reserves which were not appropriations of surplus, such as depreciation on buildings, machinery, etc., were not included. From the sum of the foregoing items were deducted such assets as were attributed to good will, patent rights, trade-marks, etc., together with the sum of all investment in property not used in the tanning of leather, such as stocks and bonds of other companies, Liberty bonds, real estate, treasury stock, etc. (p. 81).

. . . . . .

The total profits which have been shown for tanners include only such profits as were derived from the production of shoe leathers. The total investment shown, however, embraced the whole operation of each company and in a number of cases included investment attributable to other operations than the

production of shoe leathers. In arriving at a rate of profit on investment, therefore, it was necessary to include not only profits earned on shoe leathers, but also profits earned on all other operations (p. 83).

Wheat Flour Milling Industry

The data for the 101 companies for the period of 1919 to 1922 are taken from a report of the Federal Trade Commission entitled *Wheat Flour Milling Industry* which was submitted May 16, 1924.

Milling investment, which is the investment in the milling business of the company (it being impossible to separate the flour milling investment from the total milling investment) was computed from the liabilities side of the balance sheet and included the capital stock, bonds, surplus, and contingent reserves. Appreciation and good will were deducted. Reserves for depreciation and bad debts were treated as deductions from plant account and accounts receivable respectively. In the reports received for the period 1913–1918 no analysis of the interest account or of notes payable was made, consequently it was impossible to arrive at the total amount of borrowed money used in the business. The amount of bonds and bond interest paid thereon was obtained, however. Although the amount of borrowed money was obtained for the period covered by the present report in order to make a comparative study for the 10-year period, it was necessary to put the figures for the 28 companies for the 4-year period on the basis of the figures available for the previous 6-year period by including in the investment only that part of the borrowed money represented by bonds. From the investment figure thus obtained, outside investments were deducted to obtain the milling investment of the company (p. 59).

. . . . . .

Milling profit, which is the profit received by the company from all sources except outside investments, is used for computing return on milling investment. To obtain the milling profit all the miscellaneous gains and losses (before deducting interest on bonds) were added to, or subtracted from, the total

operating profit of the company, according to whether they showed a gain or a loss. The income from outside investments was then deducted to obtain the milling profit (p. 60).

Petroleum Industry

The data for the 76 concerns producing crude petroleum for which profits are reported in the years 1922 to 1925, inclusive, are found in Table 77, on pages 281 and 282, of a report by the Federal Trade Commission entitled *Petroleum Industry: Prices, Profits, and Competition* which was submitted on December 12, 1927. In referring to these data the Commission describes them as follows:

> The Senate resolution in response to which this inquiry was made directed the commission to ascertain the profits of the principal companies engaged in each branch of the petroleum industry for the period 1922 to 1925, inclusive. There are probably 15,000 or 16,000 individuals and companies engaged in the production of crude petroleum in the United States. In 1923, the latest year for which the Commissioner of Internal Revenue reported separately petroleum producers, there were 3,742 corporations engaged in crude production. In 1926 producers were operating 318,600 oil wells with an average daily production of 6.6 barrels. There was a wide range in the average daily production of crude petroleum for different sections of the country; for example, in 1926 the range by fields was from about one-half a barrel per day in the Appalachian field to 54.2 barrels for the California fields. The range for individual wells and for different producers was from a fraction of a barrel to thousands of barrels per day. On account of the smallness of their operations many individuals, and indeed a considerable number of companies, engaged in production do not have adequate records of their operations. Consequently, report forms were sent to a comparatively limited number of companies engaged in crude production, that it was believed would be able to furnish profits which would be representative of the producing business. The data on investment and profits presented in this chapter are for companies engaged solely in crude petroleum production. . . .
>
> As already stated financial data were reported by crude

petroleum producing companies on forms prepared by the commission and sent to the larger producers. From these reports investment was computed on two bases, (1) the company investment and (2) the petroleum investment, i.e., the total investment employed in the crude petroleum producing business. The average of the investment at the beginning and at the end of each year was used as the investment for that year. The company, or stockholder's investment is obtained by adding together capital stock, surplus, and such reserves as reserves for Federal taxes, contingencies, insurance, and similar appropriations of surplus. The investment in the crude petroleum producing business was obtained by adding long-term borrowings and advances from associated and affiliated companies, to the company or stockholder's investment, and deducting the amount of outside investments, such as stocks and bonds of other companies, Liberty bonds and other Government securities, and similar items.

The net income was computed similarly. In the main the net inapplicable to the company investment was used as reported by the company, before the payment of bond interest and Federal taxes, but in certain cases it was necessary to make surplus adjustments to cover such items as fire losses and profit or loss on sale of salvaged equipment, which were not part of the year's income from operations.

Since the returns cover a period of four and one-half years, the losses on abandoned wells and all drilling charges were included in operating expenses. While it might be more equitable for such charges to be distributed over a longer period, it was considered that the period covered was long enough to justify the present treatment. Otherwise it would be necessary to throw such items out of costs entirely or to arbitrarily adjust the costs by prorating such items over a longer period.

The income for the crude petroleum producing business was obtained by adding to the stockholders' income interest paid on long term borrowings and advances, including the amortization charged and deducting the income from outside investments (pp. 266–267).

. . . . . .

In this inquiry the book value of the investment in the company has been used whenever it could be ascertained, and

discovery value, revaluations, good will and appreciation have usually been eliminated from investment as far as possible after the first general statement (p. 269).

The data for the 60 concerns in the Petroleum Refining business for the years 1922 to 1925, inclusive, are found in Table 87, on page 299, of the report last referred to above. The method of calculating investment and earnings for refining companies is identical with the method used for the crude producing companies. One other item that the Commission calls attention to should be mentioned here.

> The elimination of discovery value and other appreciation had much less effect on the rate of return for the refining companies than for the producing companies because the investment in producing properties is only a part of the total investment of the refining companies which own production, as they frequently have pipe lines and marketing equipment as well as refineries and producing property. Yet it will be observed that in 1925 the amount deducted from investment for discovery value and other appreciation was $399,158,000, or 8 per cent of the total company investment, whereas, the amount restored to income for depletion and depreciation on appreciated investment was only $20,251,000, or less than 4 per cent of the net income. This would indicate that the average charge for the depreciation and depletion made by the refining companies on the discovery value and other appreciation was only 5 per cent (p. 291).

Steel Industry

The data for the 78 concerns for which profits are reported for the years 1915 to 1918, inclusive, are found in the Appendix, Table 3, page 135, of a report by the Federal Trade Commission entitled *War-Time Profits and Costs of the Steel Industry*. This report was submitted February 18, 1925. The 78 concerns do not include the United States Steel Corporation. With regard to these data the Commission reports as follows:

> During the latter part of the war, in order to obtain information on the results of Government price fixing of steel products

additional to that afforded by comparison with costs, the commission sent out a request to the various iron and steel companies, iron-ore companies, and coke companies, which were reporting costs, for certain data regarding investment and earnings. In order to have a broad basis of comparison, information was requested by quarters for the companies' fiscal years, 1915, 1916, 1917, and 1918. The information called for was substantially as follows:

Investment: (1) Capital stock; (2) bonds; (3) surplus.

Earnings: (1) Net income from operations; (2) other net income; (3) total net income; (4) Federal income and excess-profits taxes; (5) interest on bonds; (6) dividends; (7) balance to surplus.

The investment which is considered here is that indicated by the amount of capital stock, bonded debt, and surplus. The earnings are taken as the net income of the company before the payment of (1) interest on bonds; (2) Federal income and excess-profits taxes, and (3) dividends. Investment and earnings, as thus computed, give generally a lower rate than that obtained by a company on its own net investment, or "net worth," but these results show more truly the profitableness of the industry. As the purpose of the report is to compare earnings, or operating profits, Federal taxes thereon, as already stated, are not deducted. While more elaborate or refined methods of calculating either investment or earnings might be employed, the available data imposed certain limitations, while legal controversies, elsewhere referred to (see p. 21), prevented the commission from systematically amplifying or verifying the information in connection with the preparation of this report. The general results arrived at, however, would not be materially changed probably by a more detailed study.

The answers to the above-mentioned inquiry, together with certain supplementary information received later to complete the year 1918, form the basis of the present report, in so far as it relates to war-time profits. An exception to this statement is found in the case of the Steel Corporation, for which the information here presented was compiled directly from its published annual reports to stockholders. The investments and earnings for all other companies which are considered here,

therefore, are those reported by the companies themselves to the commission.

In this connection it may be noted that the amortization of the cost of construction of certain war facilities was sometimes treated as depreciation; similarly excess construction cost due to the war. In the case of one company a heavy loss, not resulting from operations, has been treated as a deduction from earnings rather than from surplus, which a stricter analysis might require (p. 28).

Southern Pine Lumber Industry

The data for the 157 companies for 1917 and the 144 companies for 1918 are taken from the Appendix, Exhibit 8, Tables 42 and 43, pages 84 to 89, inclusive, of a report by the Federal Trade Commission entitled *War-Time Costs and Profits of Southern Pine Lumber Companies*. This report was submitted May 1, 1922. The Commission reports as follows with regards to the meaning of rates of earnings on total investment:

The rates of earnings on investments shown in the table are computed on the basis of total capital invested, including capital used in the lumber business and outside investment, and the total earnings from all sources before deductions are made for interest and income and excess-profits taxes paid (p. 83).

Retail Furniture Stores

The data for the 355 Retail Furniture Stores for the years 1920 and 1921 are taken from Table 24, page 97, of a report by the Federal Trade Commission entitled *House Furnishing Industries, Vol. I, Household Furniture*. This report was submitted January 17, 1923. With regard to these data the Commission states:

Character of Returns.—Financial schedules were sent to 2,775 selected concerns listed in trade directories as retailers. Of these, many replied to the effect that they did not handle furniture, others had ceased to do so, many had gone out of business. A large number of the reports filed were incomplete. Many reports were found unusable, particularly reports from

dealers doing from $10,000 to $50,000 worth of business a year. Many dealers had kept no books or inadequate books. Some could furnish balance sheets but no income statements. A few could furnish income statements but no balance sheets. Many of the shortcomings of the schedule returns could have been remedied had additional time and money been spent in correspondence seeking to complete and correct them. Whenever practicable the commission sought to complete the reports by sending new forms and specifying the data to be furnished. Out of the whole number of reports received 564 were found workable, and are tabulated in Appendix Tables 54 to 81 (pp. 449–484).

. . . . . .

Accounting Methods Used.—The principles followed in computing invested capital and profits from the data furnished in the retailers' schedule are the same in general as those set forth in Chapter III as applied to manufacturers (see pp. 62 to 64).... (p. 88).

Method of Computing Investment.—The investment, as the term is used in this chapter, is the amount invested in the furniture business of the manufacturers concerned. This is shown both as a whole and as consisting of two parts, namely, (1) proprietor's equity or net worth invested in the furniture business, and (2) net borrowed funds used in the furniture business. The investment thus excludes outside investments such as Government bonds or investments in the stock or bonds of other companies (whether furniture companies or not). The deduction of such outside investment leaves the amount which the manufacturers' concerns are using in their own corporate, partnership, or individual business.

There has been no revision by the commission of the figures reported on the balance sheets. The elements of investment there shown have been set up in accordance with the methods stated below in order to arrive at the figures of investment shown. The method of averaging investment at the beginning of the year with that at the end after deducting the year's profit is explained later.

The whole invested capital was treated as consisting of the total assets (after deducting all proper allowances for deprecia-

tion, uncollectable accounts and the like, also omitting the items of good will where it appeared as an asset) less two deductions, namely, (1) outside investment and (2) ordinary trade debts payable. The latter consist of trade accounts payable, trade notes payable, and the like, also accrued pay roll and other accrued liabilities. However, if it appeared that the company was financing its current capital needs by borrowing largely from supply houses on its trade notes payable rather than by borrowing from the banks, these trade notes payable were not deducted. . . .(p. 62).

. . . . . .

Items Excluded in Arriving at Profits.—In counting the profit all income from outside investments was excluded from the computation (but its affect on surplus was allowed to stand). Thus the profit shown is that made in the manufacturer's own business and is comparable with the investment shown, which is that invested in his business. All profits or losses on the sale of plant equipment or other capital assets were also excluded from the profits shown. Reserves for bad debts and for discounts were likewise wholly excluded; only amounts actually written off were counted. All interest paid or payable was treated as interest on borrowed funds. Where there were outside investments so that a part of the borrowed funds was treated as invested outside the business, the interest on indebtedness was divided pro rata and only the portion assigned to "net borrowed funds" was included in the computation of the profit on the proprietor's net equity (p. 64).

Stove Manufacturers

The data for the 78 stove manufacturers are taken from the Appendix, Table 13, page 183, Vol. II, of the report by the Federal Trade Commission noted under the Furniture Manufacturing Industry above. This volume of the report was submitted October 1, 1923. In reference to these data the Commission states:

Financial reports covering operations in the years 1920 and 1921 were received from 35 manufacturers who make coal and wood stoves only, 9 who make gas stoves only, 4 who make

oil stoves only, 25 who make coal, wood, and gas stoves, and 5 who make coal, wood, gas, and oil stoves. These 78 manufacturers probably produce about three-fifths of the output of the stove industry. The two years covered were years of very different business conditions; boom times of the first half of 1920 were followed by the buyers' strike and a marked depression which lasted through the remainder of 1920 and all of 1921. In spite of the half year of depression in 1920, these 78 manufacturers netted an aggregate profit of $12,868,000, which amounted to 16.9 per cent on the initial investment of $76,225,000, including borrowed money; of 15.6 per cent on the average investment of $82,548,000, including borrowed money. In 1921 the net result of their operations was an aggregate profit of $940,000. This was only 1.12 per cent of the $83,860,000 of initial investment for that year, or 1.11 per cent of the year's average investment. Salaries of officers supplemented profits only to the extent of 2.7 per cent of the average investment in 1920 and 2.5 per cent in 1921.

Initial and average investment differ in that the first covers the investment as of the beginning of the year (with adjustments for capital added or withdrawn during year), while average investment is the average of the investment at the beginning and at the end of the year. In essence the difference is that the average investment includes one-half of the profit made during the year, while the initial investment includes none of this profit (pp. 5–6).

The earnings ratios we analyzed are based on initial investments.

Washing Machine Manufacturers

The data for the 35 washing machine manufacturers are taken from the Appendix, Table 23, page 313, Vol. III, of the report noted under the Furniture Manufacturing Industry above. This report was submitted on October 6, 1924. In reference to these data the Commission states:

In total, usable reports were received from 35 manufacturers of washing machines. These had an aggregate averaged investment of $16,595,000 in 1920 and $19,033,000 in 1921. Thirty

of the reporting companies were members of the American Washing Machine Manufacturers' Association, which in January, 1922, had 63 members. The aggregate sales according to the association in 1921 were about $26,013,000. The sales in 1921, of the 30 association members who reported in this inquiry were $18,967,000. These 30 companies thus represent nearly 73 per cent of the sales reported by the association in that year. All manufacturers of washing machines, however, are not members of the association. Preliminary figures of the Bureau of the Census for the year 1921 (released April 3, 1923) show that there were 138 establishments making washing machines, with aggregate sales of $32,444,000. On this basis the whole 35 companies reporting to the commission make about 59 per cent of the total machines produced. . . .

The earnings ratios analyzed here are based on the average investment for the year.

Investment of Manufacturers.—The aggregate averaged investment in 1920 of the 35 washing machine manufacturers who reported in this inquiry was $16,596,000 and their aggregate profits $3,651,000. These profits represented a return on the averaged investment of 22 per cent, or a return of 24.7 per cent on their initial investment of the year, which aggregated $14,771,000. In 1921 only 12 companies out of the 35 netted profits and the aggregate of all was a net loss of $90,000. This represented a loss of a little less than one-half of 1 per cent, whether measured on the basis of the aggregate averaged investment of $19,033,000 or of the aggregate initial investment of $19,078,000.

Since the officers of a company are frequently the principal stockholders or owners, and since they may have an incentive to take their return in the form of large salaries, which may be counted among the operating expenses rather than in formal profits, an examination of the salaries of officers and proprietors and their relation to the investment is always in point. Twenty-seven of the 35 washing machine manufacturers reported officers' salaries. . . .

Thus officers' salaries supplemented formal profits only to the extent of 4.3 per cent in 1920. This is not large in compari-

son with 22.8 per cent of formal profits. Officers' salaries were 19 per cent less in amount in 1921 than in the preceding year; and officers' salaries and formal profits combined averaged only 3.4 per cent of the averaged investment (pp. 52–54).

Retail Hardware Stores

The data for the 70 retail hardware stores are taken from the Appendix, Table 72, page 341, Vol. III, of the report noted under the Furniture Manufacturing Industry above. The earnings ratios are based on average investments for the year.

> Seventy retail hardware stores . . . , selling varying proportions of kitchen furnishings and domestic appliances, furnished usable reports to the commission for the years 1920 and 1921.
>
> . . . . . .
>
> The number of stores for which the above data are reported is of necessity a small proportion of the total number of retail hardware stores in the United States, but they are believed to be fairly representative, as varying conditions as to size and location were duly regarded in making the list of companies. The range in investment of retail hardware stores was from $7,000 to over $900,000. These stores are located in all parts of the United States (pp. 250–251).

II. An Analysis of the Justification for Excluding Certain Extreme Items from the Individual Distributions

Thus far we have not attempted to consider the reasons which might justify us in excluding the extreme items. In a sense this justification is not essential, since our results are about the same in either case. Nevertheless, when this point is considered, certain questions arise which throw some light on the possibility that our distributions are really heterogeneous or seriously affected by the uncontrolled conditions under which the individual earnings ratios were computed.

It will not be amiss, therefore, to submit the information

which is available, although it is extremely incomplete. The material which allows the best check, as previously noted,[1] is connected with the Public Utility data. An examination of the individual companies which were affected by the eliminations and of certain information appearing in connection with these companies will be instructive. To facilitate this discussion Table I has been prepared and presents the name

TABLE I

COMPANIES WHOSE EARNINGS RATIOS WERE AFFECTED BY THE ELIMINATION OF EXTREME ITEMS FROM THE TEN DISTRIBUTIONS OF NUMBER OF COMPANIES BY EARNINGS RATIOS

(*Public Utility Data*)

Name of Company	Type of Company	Location of Company	Number of Times an Earnings Ratio for these Companies was Present	Number of Times an Earnings Ratio for these Companies was Eliminated
Consolidated Gas Co. of Pittsburgh (L)	Gas & Elec.	East	4	4
Yadkin Power Co. (H)	Gas & Elec.	South	10	8
Philadelphia Rapid Transit Co. (H)	Traction	East	10	7
Northern Ohio Elec. Co. (H)	Holding	Middle West	5	5
Mohawk Valley Co. (H)	Holding	East	10	5
Consolidated Gas Co. (L)	Gas	East	10	1
United Traction Co. (L)	Traction	East	10	1
International Railway (L)	Traction	East	8	1
Long Island Lighting Co. (H)	Gas & Elec.	East	10	1
Utah Securities Corp. (H)	Holding	West	6	1
Schenectady Railway (L)	Traction	East	10	1
Totals			93	35

of the company affected by the eliminations, the number of times the earnings ratios of these companies appeared among the ten yearly distributions of earnings ratios, and the number of times the earnings ratios of these companies were eliminated. The letters in parentheses following the name of each company indicate whether the earnings ratios were eliminated because they were extremely low (L) or extremely high

[1] See p. 161

(H). In addition the type of company and its general geographical location is indicated. An examination of Table I shows rather conclusively that, since the same companies appear repeatedly, a smaller number of companies than of

TABLE II

COMPANIES WHOSE CHANGES IN EARNINGS RATIOS WERE AFFECTED BY THE ELIMINATION OF EXTREME ITEMS FROM THE DISTRIBUTIONS OF NUMBER OF COMPANIES BY YEARLY CHANGES IN EARNINGS RATIOS

(*Public Utility Data*)

Name of Company	Type of Company	Location of Company	Number of Times an Earnings Ratio Change for these Companies was Present	Number of Times an Earnings Ratio Change for these Companies was Eliminated
Consolidated Gas Co. of Pittsburgh	Gas & Elec.	East	4	1 (D)
Yadkin River Power Co.	Gas & Elec.	South	10	2 (2 I)
Philadelphia Rapid Transit Co.	Traction	East	10	1 (I)
Northern Ohio Electric Co.	Holding	East	5	1 (D)
Consolidated Gas Co.	Gas	East	10	1 (D)
United Traction Co.	Traction	East	10	2 (1D & 1I)
International Railway	Traction	East	8	1 (D)
Long Island Lighting Co.	Gas & Elec.	East	10	2 (1D & 1I)
Utah Securities Corp.	Holding	West	6	2 (1D & 1I)
Schenectady Railway	Traction	East	10	2 (1D & 1I)
United Electric Light Co.	Gas & Elec.	East	9	2 (1D & 1I)
Citizen's Gas Co. of Indianapolis	Gas & Elec.	Middle West	8	2 (2D)
Consumers Gas Co.	Gas & Elec.	East	10	1 (D)
East Ohio Gas Co.	Gas & Elec.	Middle West	8	2 (1D & 1I)
Associated Gas & Electric Co.	Gas & Elec.	East	6	1 (D)
Minneapolis Gas & Light Co.	Gas & Elec.	Middle West	9	1 (D)
Brooklyn City Railroad	Traction	East	4	1 (I)
Totals			147	25

ratios is eliminated. The total 35 eliminations of individual ratios from the ten distributions involved only 11 companies and five of these companies accounted for 29 of the 35 eliminations.

At this point in the investigation, the writer questioned whether approximately the same companies were concerned,

also, in the elimination of extremes from the distributions by changes in earnings ratios. Table II gives the same type of information as is presented in Table I with reference to the eliminations from the second type of distributions analyzed. Table II also indicates whether the earnings ratio change was eliminated because it was an extreme decrease (D) or an extreme increase (I).

The first point that requires our attention is the recurrence of ten of the 11 companies from Table I. This fact must indicate that in some one year, at least, the companies that were on the extremes in actual earnings ratios suffered a change in earnings ratio of much greater magnitude than the usual amount of change of all companies collectively. Furthermore, in many instances two such changes are indicated, and they are generally in opposite directions. The 25 eliminations affected 17 companies and no company was affected more than twice during the ten-year period.

Before examining why these companies differed from the others with respect to either their earnings ratios or their changes in earnings ratios between successive years to an extent which brought them into the class of eliminations, we can cite what little evidence we have about the distributions derived from the reports of the Federal Trade Commission. Since the making of many tables is tedious and does not advance the exposition beyond a certain point, it will suffice merely to note that the eliminations for these distributions behaved in exactly the same way as those for the Public Utility Industry. A few companies account for the extremes in earnings ratios and these same companies are generally found among the extremes when changes in earnings ratios are analyzed. The data supplied by the Federal Trade Commission Reports do not allow us to go any further than this, since we can only identify the companies by number and not by name.

In the case of the Public Utility data, however, we can proceed a little further. Through the coöperation of Mr. A. H. Winakur, of the Bureau of Research of the University of

Illinois, certain information about the balance sheets of the companies involved in the eliminations was made available. In some instances, no significant reason to account for the extremes could be discovered, but certain cases about which information was available are instructive and worthy of comment.

With regard to extremely high earnings ratios, the Philadelphia Rapid Transit Company, the Northern Ohio Electric Company, and the Utah Securities Corporation furnish instructive instances and take care of 13 of the 27 eliminations because of very high earnings ratios. The Philadelphia Rapid Transit Company shows a consistently high ratio of net earnings to total assets, but a very low ratio of net income to total assets. Inquiry reveals that rentals to underlying companies are included as fixed charges. This means that the net earnings ratio is large because the assets on the basis of which the rentals are paid are not included in the total assets (at least in proportion to the rentals paid). In the case of the Northern Ohio Electric Company (which is a holding company), preferred stock dividends are included as fixed charges, and in the case of the Utah Securities Corporation we find an extremely high net earnings ratio for the year 1922, because up to that year an item of securities pledged had appeared and accounted for about 80 per cent of the total assets. In 1922 this item disappears, and we secure a high net earnings ratio—not because net earnings increased but because total assets decreased by approximately 61.39 per cent.

Some light (conjecturally, at least) can also be thrown upon certain cases in which the earnings ratios between successive years decreased or increased by extraordinary amounts when compared with the recorded changes for other companies. The following companies furnish instructive evidence: Philadelphia Rapid Transit Company, Long Island Lighting Company, Utah Securities Company, and Associated Gas and Electric Company. Between the years 1917 and 1918, the net earnings ratio for the Philadelphia

Rapid Transit Company increased by 9.34 per cent, but the total assets decreased by 52.86 per cent. In the case of the Long Island Lighting Company, the net earnings ratio decreased by 7.29 per cent between the years 1921 and 1922, but the total assets increased by 134.92 per cent. The case of the Utah Securities Company has already been cited. The Associated Gas and Electric Company showed a decrease in earnings ratios between 1921 and 1922 of 5.32 per cent, with an increase in total assets of 128.15 per cent. This same company showed another decrease in its net earnings ratio between 1923 and 1924 of 3.92 per cent, but an increase in total assets of 457.69 per cent.

If we remember that the balance sheets for the companies in the Public Utility sample were examined by accountants and made as nearly comparable as possible, the existence of such cases may seem to throw considerable doubt upon the advisability of the type of analysis in which the present writer is engaged. Perhaps this evidence should have been cited first and then the study never attempted! But such an appraisal is not necessarily warranted. In the first chapter, we admitted that net earnings were subject to the vagaries of depreciation and obsolescence charges, and to the inclusion of high executive salaries. In addition, the basis for computing the ratios (total assets) is subject to changes based upon reorganizations, accounting practices, etc. Furthermore, the author dislikes to make the plea that since the analysis is always in terms of group characteristics the errors introduced by individual variations from the true measures cancel each other. This plea should only be made when we know much about the nature of the errors and can state that they are really compensating errors. Nevertheless, a further analysis of the data has convinced the writer that the information derived from these data, even in its imperfect form, is valuable, and that the method of analysis is even more valuable and would be productive of more positive results if the original data were better controlled in their preliminary stages of compilation.

The hope for better data springs eternal in the social scientist but attainment of them is a goal which, when reached, fails to satisfy, for with them comes a realization of the need for still greater perfection. We must proceed with the material at our disposal, but in so doing we need not claim more for our findings than the imperfect data warrant. Only when we have clearly defined what we want, and shown how to use it by analyzing the data available can we hope to succeed in giving some empirical foundation to the science of economics.

The evidence that is about to be presented has convinced the writer that the general group characteristics of the data analyzed would not be materially altered by the use of more refined data. If the data were more refined by control, our conclusions could be more positive and more definitely associated with profit theory, but even in their present state they are suggestive even for profit theory. What we desire to know is whether, on the whole, total assets change in such a manner as to indicate no reliability for ratios based upon them. It should be made clear, at this point, that the persistence of the same companies on the extremes of the distributions is only conjecturally in favor of their elimination. Perhaps they are "sports" and not true members of the distributions, but of this we cannot be certain. Even large changes in total assets are not complete evidence that the new earnings ratio is not the correct one.

In the attempt to discover the extent to which total assets change and affect earnings ratios, the following four points have been investigated: (1) the correlation between the ranking of the concerns by size in successive years, (2) the frequency distributions of percentage changes in total assets between years, (3) the correlation between percentage changes in total assets between years and the net earnings ratios in the first year, and finally (4) the correlation between percentage changes in total assets and the amount of change in earnings ratios between years.

Table III presents the coefficients of correlation derived when the concerns were ranked in each year and their ranks

in successive years correlated. The sizes of the coefficients are remarkable and show that, although concerns may change in regard to the size of their total assets, these changes are not large enough to affect their rankings materially. This does not mean that changes may not be large, since differences in the size of concerns may be sufficient to allow material change without disturbing the rankings to any significant extent. The material does indicate, however, that there is a much greater stability in rank by size than by earnings ratios. The shifting in earnings ratios does not appear

TABLE III

RANK CORRELATION BETWEEN THE SIZE OF PUBLIC UTILITY COMPANIES IN SUCCESSIVE YEARS AS MEASURED BY THEIR TOTAL ASSETS

Years	Coefficients of Rank Correlation
1915–16	.9974
1916–17	.9761
1917–18	.9841
1918–19	.9976
1919–20	.9873
1920–21	.9938
1921–22	.8211
1922–23	.9919
1923–24	.9845

to be entirely the result of shifting in the amount of total assets.

In the light of this analysis, the distributions of percentage changes in total assets between successive years are, at first glance, rather startling. Table IV presents these distributions, and we see immediately the tremendous changes exhibited by some companies. On the other hand, approximately one-third of the companies never shift the size of their total assets between successive years by more than four per cent, while a change of ten per cent will include over fifty per cent of the changes. Furthermore, we know that in only 25 instances did the change in earnings ratios fall outside the general outlines of the distributions based upon numbers of

TABLE IV

Frequency Distributions of Number of Corporations by Percentages of Change in Total Assets between Successive Years

(Public Utility Data)

Percentage Change in Total Assets	1915–16	1916–17	1917–18	1918–19	1919–20	1920–21	1921–22	1922–23	1923–24
		(−70.0)*	(−52.9)				(−61.4)	(-41.1)	
(−39.995)–(−35.995)		1					1		
(−35.995)–(−31.995)							1		
(−31.995)–(−27.995)				1				1	
(−27.995)–(−23.995)									
(−23.995)–(−19.995)					1			1	1
(−19.995)–(−15.995)					1	1			1
(−15.995)–(−11.995)					1		2	1	1
(−11.995)–(− 7.995)			1			3	2	1	1
(− 7.995)–(− 3.995)			1	3		5	4	4	1
(− 3.995)–(.005)	7	6	17	27	20	22	21	19	20
.005– 4.005	53	52	51	63	61	73	64	56	54
4.005– 8.005	17	16	18	23	23	26	22	18	29
8.005– 12.005	6	8	10	5	16	8	16	16	18
12.005– 16.005	3	9	4	6	15	9	10	12	8
16.005– 20.005	2	2		2	5	3	3	8	8
20.005– 24.005	2	2	1	2	2	3	3	11	5
24.005– 28.005	1	1	1	1		3	2	6	2
28.005– 32.005		1	3		2		3	1	4
32.005– 36.005	1		1	1	1		2	7	2
36.005– 40.005						1	1	2	3
40.005– 44.005			1				1	1	2
44.005– 48.005						1		1	1
48.005– 52.005				1					2
52.005– 56.005			1				1	1	1
56.005– 60.005		1					1		
60.005– 64.005									
64.005– 68.005									
68.005– 72.005		1	1						
72.005– 76.005		1			1				1
76.005– 80.005									
80.005– 84.005			1						
		(92.2)			(91.7)				(111.5)
		(121.7)					(128.1)		
				(151.7)			(134.9)		
			(212.7)	(203.4)	(206.3)				
									(457.7)
Totals	92	104	114	137	151	158	163	168	167

* The numbers in parentheses are actual percentage changes beyond the convenient limits of the table.

companies by changes in earnings ratios. The number of percentage changes in total assets which are large seems unusual and the size of the percentage changes in some few instances seems beyond any reasonable expectation. Perhaps this fact means that some earnings ratios were kept within bounds by shifting the total asset figures. It must be remembered, however, that every material or unusual increase in total assets is not necessarily a sign of manipulations. If the increase is really represented by material assets accumulated through new developments or consolidations, the earnings ratio of the next year should be based upon the new amount of total assets.

TABLE V

CORRELATION BETWEEN EARNINGS RATIOS IN ONE YEAR AND PERCENTAGE CHANGES OF TOTAL ASSETS IN THE SUCCEEDING YEAR

(*Public Utility Data*)

Years	Number of Concerns	Coefficients of Correlation	Means of the Percentage Changes in Total Assets between the Years	Means of the Earnings Ratios in the First Year
1915–16	92	.05	4.74	5.18
1916–17	104	.28	8.08	5.48
1917–18	114	.11	7.90	5.16
1918–19	137	.09	6.18	4.75
1919–20	151	.09	7.51	5.02
1920–21	158	.12	4.23	5.00
1921–22	163	.27	6.74	5.08
1922–23	168	.26	8.31	5.99
1923–24	167	.06	11.97	5.79

In order to get some idea of the relationships between percentage changes in total assets and earnings ratios, or changes in earnings ratios, two-way frequency tables have been prepared for these variables and the coefficients of correlation computed. The two-way frequency tables show almost conclusively that little, if any, correlation exists between either percentage changes in total assets between successive years and earnings ratios in the first year, or percentage changes in total assets between years and the changes in

earnings ratios between years. In the case of some few extreme items, we do find a suggestion of correlation. Samples of these two-way frequency tables are presented in Tables XVIII and XIX of Appendix B. Tables V and VI of this appendix exhibit the coefficients of correlation which resulted from the numerical computations, along with the means of the percentage changes in assets and the means of the earnings ratios or the means of the changes in earnings ratios.

TABLE VI

CORRELATION BETWEEN CHANGES IN RATES OF EARNINGS BETWEEN SUCCESSIVE YEARS AND PERCENTAGE CHANGES IN TOTAL ASSETS

(*Public Utility Data*)

Years	Number of Concerns	Coefficients of Correlation	Means of the Changes in Earnings Ratios between the Years	Means of the Percentage Changes in Total Assets between the Years
1915–16	92	—.13	.34	4.77
1916–17	104	—.31	—.44	8.08
1917–18	114	—.09	—.64	7.90
1918–19	137	.24	.15	6.18
1919–20	151	—.27	—.17	7.51
1920–21	158	—.04	.27	4.23
1921–22	163	—.45	.79	6.74
1922–23	1 8	—.15	—.18	8.31
1923–24	167	—.25	—.18	11.97

The coefficients of correlation between percentage changes in total assets and earnings ratios in a given year are all positive, but extremely small. An inspection of the two-way frequency tables which are presented for the years when the correlation is both highest and lowest shows conclusively that even the degree of correlation recorded is misleading and is really based upon one or two items on the extremes of the distributions. The sign of the coefficients is in line with expectations, since we should expect concerns with high earnings to grow faster than concerns with low earnings. We do not find enough cases where earnings rates are reduced by increasing the total assets, to give any significant correlation. In competitive industries, higher correlation would appear to be more reasonable.

In general, the sign of the coefficients of correlation based upon percentage changes in assets and changes in earnings ratios is negative, but likewise small. Even this degree of correlation is surprising in the light of the frequency tables and is again due largely to a few extreme items. The negative correlation is not reasonable, since we should expect the concerns showing a significant falling off in earnings to decrease their size and not to increase it. But what is really true is that, with the exception of the few extreme items, there is no correlation present.

The net conclusion of this analysis, in the opinion of the writer, is that some extreme items should be excluded. Whether we have excluded enough or too many is hard to say. Little difference developed in our general conclusion when we made the elimination which we did make, and in all probability a few eliminations more or less would not change the conclusion, either. Skewness, for a large part of our data, was based upon the Bowley measure, and this considers only the middle half of the data. The median, as the measure of central tendency, is not affected very materially by extreme items, and the inter-quartile range as a measure of dispersion showed about the same thing as the standard deviations. Curve type and the values of β_2 and r were modified, but never to a degree which would suggest that our distributions were normal, or approximately so. Our analysis of curve type was never intended to be used as the basis for the derivation of good fitting analytical functions, but merely as a basis for studying the difference between earnings ratio distributions and stable distribution of the normal or Type III variety.

APPENDIX B

TABLE I. YEARLY FREQUENCY DISTRIBUTIONS OF NUMBER OF

(*Federal Trade*

Earnings Ratios 10% Class Intervals[1]	Shoe Manufacturing[2]						Tanning[3]		
	1914	1915	1916	1917	1919	Av. 1914–17	1914	1915	1916
(−99.995)–(−89.995)									
(−89.995)–(−79.995)									
(−79.995)–(−69.996)									
(−69.995)–(−59.995)									
(−59.995)–(−49.995)	1†								
(−49.995)–(−39.995)									
(−39.995)–(−29.995)									
(−29.995)–(−19.995)		1		3			1		
(−19.995)–(− 9.995)	3	4			1				
(− 9.995)– .005	19	14	3	5	4	2	1		
.005 – 10.005	67	74	18	28	22	40	22	18	8
10.005 – 20.005	87	77	80	71	97	96	17	21	8
20.005 – 30.005	30	32	57	64	79	53	9	7	15
30.005 – 40.005	19	17	35	41	58	23	2	3	7
40.005 – 50.005	5	14	22	16	38	15		3	5
50.005 – 60.005	3	2	7	3	18	7			3
60.005 – 70.005	1	1	7	4	9				3
70.005 – 80.005	1		2	1	5	1		1	2
80.005 – 90.005	1	1	4		3				
90.005 – 100.005			2	1	5				
100.005 – 110.005	1								
110.005 – 120.005					2				
120.005 – 130.005									
130.005 – 140.005									
140.005 – 150.005				1					
150.005 – 160.005			1						
160.005 – 170.005									
170.005 – 180.005									
180.005 – 190.005									
190.005 – 200.005									
200.005 – 210.005									
210.005 – 220.005									
220.005 – 230.005									
230.005 – 240.005									
240.005 – 250.005									
250.005 – 260.005									
260.005 – 270.005									
270.005 – 280.005									
280.005 – 290.005									
290.005 – 300.005									
Total companies	238	237	238	238	341	237	52	53	52

* The methods employed in the calculation of the earnings ratios are recorded in Appendix A.

† Items in parentheses represent actual earnings ratios which are so extreme as to involve too many for certain computations specified in the text.

[1] In classifying the data the class intervals were stated with one more decimal place than the original

[2] The data for the years 1914 to 1917, inclusive, are taken from the Federal Trade Commission's data are taken from the Federal Trade Commission's *Report on Shoe and Leather Costs and Prices*, by adding the successive ratios and dividing by the number of years.

[3] Data for the years 1914 to 1917, inclusive, and for 1919 are taken from the same reports as those ond report. The average data for the years 1914–17 were calculated by adding the successive ratios and

[4] The data for the years 1915 to 1918 are taken from the Federal Trade Commission's *Report on War*-135. The average earnings for these years are the true averages as reported in Table III.

[5] These data are taken from the Federal Trade Commission's report on *Wheat Flour Milling Industry*,

COMPANIES BY EARNINGS RATIOS FOR ELEVEN INDUSTRIES*

Commission Data)

Tanning (*Cont.*)			Steel[4]					Wheat Flour Milling[5]				
1917	1919	Av. 1914–17	1915	1916	1917	1918	Av. 1915–18	1919	1920	1921	1922	Av. 1919–22
										1		
										1		
									1			
										1		
										4	*1*	
										3		
			2					1	4	15	1	2
			6		1	5		1	15	33	15	12
1	4	6	33	3	4	18	5	25	27	33	47	47
21	13	22	19	12	6	23	14	44	32	11	26	39
14	10	12	11	15	11	12	15	20	19	4	5	6
8	5	7	2	13	10	10	17	6	6		3	2
6	3	3	3	10	8	10	8	3	1	*1*	3	
1	1		2	2	6	2	8	1				
1	*3*			5	6		4					
	1	*1*		7	8	4	1					
1	*3*			4	4	2	1					
	4			1	4		2					
	5				4							
	3			*1*	2		*2*					
	1				2	*2*						
					1		*1*					
				1		*1*						
				1		*1*						
					1							
				2								
53	56	51	78	78	78	91	78	101	105	107	101	108

class intervals for convenient reproduction in the tables. The italicized frequencies are the items omitted

data so that the limits of the classes are clearly defined.

Report on Leather and Shoe Industries, August 21, 1919, Table 39, pp. 100–103. For the year 1919 the June 10, 1921, Appendix Table 36, pp. 207–211. The averages for the years 1914–17 were calculated

cited under Footnote 2. See Table 7, p. 27 in the first report, and Appendix Table 35, p. 206 in the sec- dividing by the number of years.

Time Profits and Costs of the Steel Industry, February 18, 1925, Appendix Tables II and III, pp. 134–

May 14, 1924, Appendix Tables III and IV, pp. 107–108.

TABLE I. (*Continued*). YEARLY FREQUENCY DISTRIBUTIONS OF NUM-

(*Federal Trade*

Earnings Ratios 10% Class Intervals[1]	Crude Petroleum[6]						Petroleum Refining[7]		
	1918	1922	1923	1924	1925	Av. 1922–25	1922	1923	1924
			(−114.3)†		(−135.7)				
(−99.995)– (−89.995)									
(−89.995)– (−79.995)									
(−79.995)– (−69.995)	1			1	1				
(−69.995)– (−59.995)			1			1			
(−59.995)– (−49.995)		1	1		2			1	
(−49.995)– (−39.995)				1					
(−39.995)– (−29.995)		2	2	3	1	1	1	1	2
(−29.995)– (−19.995)		4	1	1	3	1		1	
(−19.995)– (− 9.995)	2	5	10	5	5	5		6	
(− 9.995)– .005	27	25	20	18	11	17	10	12	11
.005 – 10.005	32	15	20	25	19	21	19	24	27
10.005 – 20.005	25	11	12	11	15	16	15	8	16
20.005 – 30.005	20	2	5	7	15	4	6	4	5
30.005 – 40.005	7	4	1	7	6	4	4	2	2
40.005 – 50.005	6	3			2				
50.005 – 60.005	5			2	1	1	2		
60.005 – 70.005	3		1	1	2		1	1	
70.005 – 80.005		1	2	4	2				
80.005 – 90.005	2			1					
90.005 – 100.005	1		1	1	1	1			
100.005 – 110.005	1					1			
110.005 – 120.005		1		1	1	1			
120.005 – 130.005	2					1			
130.005 – 140.005									
140.005 – 150.005		1							
150.005 – 160.005									
160.005 – 170.005			3						
170.005 – 180.005						1			
180.005 – 190.005			1						
190.005 – 200.005			1						
200.005 – 210.005									
210.005 – 220.005					1				
220.005 – 230.005									
230.005 – 240.005									
240.005 – 250.005		1							
250.005 – 260.005									
260.005 – 270.005									
270.005 – 280.005									
280.005 – 290.005					1				
290.005 – 300.005									
Total companies	134	76	83	89	90	76	58	60	63

[6] Data for the year 1918 are taken from the Federal Trade Commission's *Report on the Pacific Coast* pp. 259–260. Data for the other years are taken from the Federal Trade Commission's *Report on the* average earnings for the four years are the simple averages computed by the writer.

[7] These data are taken from Table 77, pp. 281–282 of the 1927 report referred to in footnote 6.

[8] These data are taken from the Federal Trade Commission's *Report on War-Time Costs and Profits*

[9] These data are taken from Federal Trade Commission's *Report on House Furnishings Industries:*

[10] *Ibid.*, Volume III, October 6, 1924, Appendix Table 72, p. 341.

[11] *Ibid.*, Volume III, Appendix Table 23, p. 313.

[12] *Ibid.*, Volume I, Diagram I, p. 119.

BER OF COMPANIES BY EARNINGS RATIOS FOR ELEVEN INDUSTRIES

Commission Data)

Petroleum Refining (*Cont.*)		Southern Pine Lumber[8]		Stove Manufacturing[9]		Retail Hardware Stores[10]		Washing Machine Manufacturing[11]		Retail Furniture Stores[12]	
1925	Av. 1922–25	1917	1918	1920	1921	1920	1921	1920	1921	1920	1921
								1	1		2
1	1				2		1		3	1	1
1	1				2		3		3		7
			2	1	10		3		5	2	16
9	6	5	15	2	25		17	4	11	8	60
25	27	75	77	17	19	10	20	10	7	64	150
23	17	53	34	31	12	30	12	8	3	123	79
3	4	17	12	13	4	11	5	5	1	77	20
1	2	3	3	7	3	6	5	4		35	14
		2		5	1	7	1	1	1	26	3
		1	1	1		3				9	1
				1						6	
						1					1
							1	1		2	
						2	1	1			1
										2	
							1				
63	58	156	144	78	78	70	70	35	35	355	355

Petroleum Industry, Part I, Production, Ownership and Profits, April 7, 1921, Appendix Table 43
Petroleum Industry: Prices, Profits and Competition, December 12, 1927, Table 77, pp. 281–282. The

of Southern Pine Lumber Companies, May 1, 1922, Exhibit 8, Tables 42 and 43, pp. 84–89.
House-hold Stoves, Volume II, October 1, 1923, Appendix Table 13, p. 183.

Table II. Yearly Frequency Distributions of Number of Corporations by Earnings Ratios*

(*Public Utility Data*)

Earnings Ratios 2% Class Intervals†	Years									
	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924
(−13.995)–(−11.995)				*1*						
(−11.995)–(− 9.995)							*1*			
(− 9.995)–(− 7.995)									*1*	
(− 7.995)–(− 5.995)						*1*				
(− 5.995)–(− 3.995)			*1*‡					*1*		
(− 3.995)–(− 1.995)	*1*	*1*		2	1	2			1	
(− 1.995)– .005			1	1	6	5	5	4	3	3
.005 – 2.005	7	5	7	16	13	13	15	5	10	16
2.005 – 4.005	21	28	33	44	50	43	38	27	28	27
4.005 – 6.005	35	38	52	49	46	61	66	70	62	52
6.005 – 8.005	21	28	16	19	27	23	27	36	44	50
8.005 – 10.005	6	6	3	3	4	7	11	18	19	16
10.005 – 12.005	1	2	2	3	5	3	3	6	5	2
12.005 – 14.005	2		1	1	1				2	2
14.005 – 16.005	1	2	2	1	1	*1*	*1*		1	1
16.005 – 18.005	1	1	1			*1*			*1*	*1*
18.005 – 20.005		1		*1*			2	2		
20.005 – 22.005					*1*	2	2			
22.005 – 24.005										
24.005 – 26.005								*1*		2
26.005 – 28.005					*1*			*1*	*1*	
28.005 – 30.005					*1*					
30.005 – 32.005			*1*	*1*						
Total companies	96	112	120	142	157	162	171	171	179	172

* See explanation on pages 62–65 for sources of these data.
† Class intervals are stated to one more decimal place than the original data, so that the class limits are definitely located.
‡ Italicized items were eliminated for certain computations, as explained in the text.

Table III. Mean and Median Earning Rates for Different Size Groups in the Public Utility Industry for the Years 1915–1924*

Year	Under $10,000,000			$10,000,000–$30,000,000			$30,000,000–$50,000,000			$50,000,000 and over		
	M	*Md*	*M*−*Md*	*M*	*Md*	*M*−*Md*	*M*	*Md*	*M*−*Md*	*M*	*Md*	*M*−*Md*
1915	5.76	5.60	+.16	5.13	4.87	+.26	5.11	5.05	+.06	4.95	4.52	+.43
1916	5.51	5.37	+1.14	5.31	4.91	+.40	5.87	6.12	−.25	5.06	4.81	+.25
1917	5.42	4.57	+.85	4.94	4.37	+.57	5.37	5.17	+.20	4.65	4.93	−.28
1918	4.51	4.00	+.51	4.24	4.11	+.13	4.95	4.36	+.59	4.65	4.96	−.21
1919	5.51	4.78	+.73	4.65	4.60	+.05	4.30	3.75	+.55	5.27	4.76	+.51
1920	5.07	4.71	+.36	4.62	4.54	+.08	4.59	4.24	+.35	4.38	4.23	+.15
1921	5.04	4.47	+.57	4.98	5.11	−.13	4.97	5.00	−.03	5.21	5.11	+.10
1922	6.47	5.18	+1.29	5.71	5.63	+.08	6.19	5.63	+.56	5.99	5.33	+.66
1923	4.65	4.52	+.13	6.22	5.79	+.43	6.25	5.98	+.27	6.15	5.19	+.96
1924	4.54	4.03	+.51	5.92	5.68	+.24	6.18	6.52	−.34	5.77	4.93	+.84

* These rates were calculated by the author from arrays of earning rates by size groups. The data used are described on pages 62–65 of the text.

Table IV. Yearly Frequency Distributions of Percentages of Total Assets by Earnings Ratios with Certain Statistical Measures*

(Public Utility Data)

Earnings Ratios 2% Class Intervals†	Years									
	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924
(−13.995)−(−11.995)				.20						
(−11.995)−(− 9.995)									.12	
(− 9.995)−(− 7.995)							.29			
(− 7.995)−(− 5.995)						1.39				
(− 5.995)−(− 3.995)			.25					.88		
(− 3.995)−(− 1.995)	.29	.26		2.15	1.46	1.47			.16	
(− 1.995)− .005			.18	.18	3.14	1.19	1.05	.80	.55	.53
.005 − 2.005	7.31	5.02	7.61	13.05	6.89	8.92	7.95	2.33	4.09	4.47
2.005 − 4.005	24.50	25.77	28.24	26.19	33.72	23.27	18.27	11.33	7.47	9.88
4.005 − 6.005	37.54	34.76	38.18	41.76	22.90	39.60	37.53	39.51	36.74	40.74
6.005 − 8.005	17.39	20.72	17.35	11.09	17.95	10.52	21.71	16.96	23.63	32.82
8.005 − 10.005	10.73	5.93	.82	1.26	1.84	2.23	10.48	22.83	22.24	7.83
10.005 − 12.005	.20	5.63	.74	1.70	9.86	9.41	.95	3.70	2.02	.44
12.005 − 14.005	1.39		.20	.18	.10				1.25	.54
14.005 − 16.005	.47	.64	5.97	.35	.30	.27	.09		.14	1.43
16.005 − 18.005	.18	.99	.20			1.27			1.02	.95
18.005 − 20.005		.26		1.65			1.32	1.27		
20.005 − 22.005					1.37	.46	.36			
22.005 − 24.005									.35	
24.005 − 26.005								.16		.37
26.005 − 28.005					.21			.16	.22	
28.005 − 30.005					.26					
30.005 − 32.005			.23	.24						
32.005 − 34.005								.07		
Total	100	100	100	100	100	100	100	100	100	100
Means (M)	5.17	5.48	5.22	4.46	5.14	4.94	5.38	6.29	6.45	5.97
Medians (Md)	4.96	5.1	4.72	4.40	4.42	4.70	5.20	5.71	6.04	5.73
Lower Quartiles (Q_1)	3.34	3.54	3.20	2.72	2.86	3.04	3.72	4.49	4.69	4.50
Upper Quartiles (Q_3)	7.76	6.88	6.07	5.60	6.77	5.95	6.92	8.20	8.21	7.19
Inter-Quartile ranges (Q_3-Q_1)	4.42	3.34	2.87	2.88	3.91	2.91	3.20	3.71	3.51	2.69
Coefficients of Dispersion $\left(\frac{Q_3-Q_1}{Md}\right)$	.89	.66	.53	.65	.88	.62	.61	.65	.58	.47
Skewness ($M-Md$)	.21	.38	.50	.06	.72	.24	.18	.58	.41	.24

* See explanation on pages 62–65 for sources of these data.

† See similar note to Table II.

TABLE V. MEDIANS, QUARTILES, SKEWNESS, AND DISPERSION MEASURES FROM YEARLY FREQUENCY DISTRIBUTIONS OF NUMBER OF CORPORATIONS BY EARNINGS RATIOS*

(*Source Book of Industrial Profits Data*)

Major Group	Year	Statistical Measures					
		Medians Md	Lower Quartiles Q_1	Upper Quartiles Q_3	Inter-Quartile Ranges Q_3-Q_1	Skewness $\frac{q_2-q_1}{q_2+q_1}$§	Coefficients of Dispersion $\frac{Q_3-Q_1}{Md}$
No. 1, Food	†1919	25.2	12.7	41.7	29.0	.14	1.15
	1920	12.2	4.9	23.5	18.6	.21	1.52
	1921	14.1	6.1	20.6	14.5	−.10	1.03
	1922	18.7	9.3	28.4	19.1	.02	1.02
	1923	14.4	9.1	23.1	14.0	.26	.97
	‡1924	15.1	9.8	21.9	12.1	.12	.80
	1925	12.8	7.2	19.8	12.6	.10	.98
	1926	12.9	7.8	20.7	12.9	.20	1.00
	1927	12.3	6.8	19.0	12.2	.09	.99
	1928	11.8	7.0	17.8	10.9	.10	.92
No. 2, Textiles	†1919	36.4	24.2	51.9	27.7	.12	.76
	1920	12.2	4.8	27.2	22.4	.34	1.94
	1921	12.2	5.8	21.9	16.1	.20	1.32
	1922	18.6	11.0	29.1	18.1	.16	.97
	1923	16.2	11.0	22.2	11.2	.07	.69
	‡1924	13.3	5.3	16.3	11.0	.20	.83
	1925	11.6	7.0	18.3	11.3	.19	.97
	1926	9.2	6.5	16.0	9.5	.43	1.03
	1927	11.6	6.8	16.8	10.0	.05	.86
	1928	8.0	3.4	13.4	10.0	.09	1.25
No. 3, Leather	†1919	34.3	22.6	48.2	25.6	.08	.74
	1920	8.0	.0	15.7	15.7	−.19	1.96
	1921	6.7	.0	14.5	14.5	.07	2.16
	1922	15.6	7.9	24.5	16.6	.07	1.06
	1923	11.3	5.9	18.2	12.3	.12	1.09
	‡1924	10.6	6.3	14.2	7.9	−.08	.74
	1925	10.7	6.7	16.8	10.1	.20	.94
	1926	10.5	3.9	15.6	11.7	.13	1.11
	1927	12.6	7.9	17.4	9.5	−.01	.75
	1928	10.3	5.3	14.1	8.8	.13	.85

See footnotes on page 287.

TABLE V (*Continued*). MEDIANS, QUARTILES, SKEWNESS, AND DISPERSION MEASURES FROM YEARLY FREQUENCY DISTRIBUTIONS OF NUMBER OF CORPORATIONS BY EARNINGS RATIOS*

(*Source Book of Industrial Profits Data*)

Major Group	Year	Statistical Measures					
		Medians Md	Lower Quartiles Q_1	Upper Quartiles Q_3	Inter-Quartile Ranges Q_3-Q_1	Skewness $\frac{q_2-q_1}{q_2+q_1}$§	Coefficients of Dispersion $\frac{Q_3-Q_1}{Md}$
No. 4, Rubber	†1919	26.0	17.0	37.0	20.0	.10	.77
	1920	7.6	4.6	17.0	12.4	.52	1.63
	1921	3.7	.0	12.5	12.5	.41	3.38
	1922	15.7	7.0	22.0	15.0	—.16	.95
	1923	12.5	8.2	17.0	8.8	.02	.70
	‡1924	11.5	6.3	16.7	10.4	.00	.90
	1925	16.9	11.3	20.8	9.5	—.20	.56
	1926	11.1	2.6	16.6	14.0	—.22	1.26
	1927	11.7	5.4	17.7	12.3	—.03	1.05
	1928	7.5	.1	12.9	12.8	—.15	1.71
No. 5 Lumber	†1919	24.2	16.8	42.8	26.0	.43	1.07
	1920	22.8	14.7	31.2	26.5	.39	1.16
	1921	6.7	2.6	14.5	11.9	.31	1.78
	1922	18.0	11.3	31.2	19.9	.33	1.10
	1923	18.1	13.4	27.0	13.6	.31	.75
	‡1924	14.3	8.6	20.9	12.3	.00	.86
	1925	13.7	8.5	21.1	12.6	.17	.92
	1926	11.8	6.8	19.2	12.4	.20	1.05
	1927	9.1	5.4	15.8	10.4	.29	1.14
	1928	9.9	5.4	15.2	9.8	.08	.99
No. 6 Paper and Pulp	†1919	24.5	15.1	41.0	25.9	.27	1.06
	1920	37.4	22.1	55.1	33.0	.07	.88
	1921	5.4	‖	‖	‖	‖	‖
	1922	14.9	7.6	25.4	17.8	.18	1.19
	1923	13.1	7.5	21.7	14.2	.21	1.08
	‡1924	11.4	6.9	17.9	11.0	.18	.93
	1925	11.5	7.0	16.6	9.6	.07	.83
	1926	11.0	6.4	17.5	11.1	.18	1.01
	1927	11.5	6.7	17.3	10.6	.08	.92
	1928	9.5	6.1	15.1	9.0	.24	.95

See footnotes on page 287.

TABLE V (*Continued*). MEDIANS, QUARTILES, SKEWNESS, AND DISPERSION MEASURES FROM YEARLY FREQUENCY DISTRIBUTIONS OF NUMBER OF CORPORATIONS BY EARNINGS RATIOS*

(*Source Book of Industrial Profits Data*)

Major Group	Year	Statistical Measures					
		Medians Md	Lower Quartiles Q_1	Upper Quartiles Q_3	Inter-Quartile Ranges Q_3-Q_1	Skewness $\frac{q_2-q_1}{q_2+q_1}$§	Coefficients of Dispersion $\frac{Q_3-Q_1}{Md}$
No. 7 Printing	†1919	24.0	14.3	37.9	23.6	.17	.98
	1920	32.5	18.7	48.7	30.0	.08	.92
	1921	18.1	9.9	28.1	18.2	.10	1.00
	1922	21.4	12.5	36.6	24.1	.25	1.13
	1923	17.6	11.3	27.0	15.7	.19	.89
	‡1924	16.6	10.1	24.2	14.1	.09	.85
	1925	16.4	9.2	24.2	15.0	.03	.91
	1926	15.5	9.9	24.0	14.1	.27	.91
	1927	12.7	6.7	20.8	14.1	.14	1.11
	1928	13.8	9.7	19.5	9.8	.16	.71
No. 8 Chemicals	†1919	24.0	14.7	43.8	29.1	.36	1.21
	1920	15.9	7.6	28.9	21.3	.22	1.34
	1921	7.7	1.5	18.2	16.7	.20	2.17
	1922	18.0	8.3	32.3	24.0	.19	1.33
	1923	14.0	7.1	23.8	16.7	.17	1.19
	‡1924	12.9	7.0	23.9	16.9	.29	1.31
	1925	13.7	7.8	26.4	18.6	.36	1.36
	1926	14.0	8.4	23.2	14.8	.25	1.06
	1927	12.6	6.1	21.0	14.9	.13	1.18
	1928	13.1	7.0	22.4	15.4	.22	1.17
No. 9 Stone and Clay	†1919	17.7	10.0	32.8	22.8	.32	1.29
	1920	18.2	11.5	34.5	23.0	.42	1.26
	1921	11.7	2.6	17.3	14.7	−.24	1.26
	1922	16.2	11.4	28.4	17.0	.43	1.05
	1923	20.8	13.6	29.2	15.6	.08	.75
	‡1924	15.7	9.3	22.4	13.1	.02	.83
	1925	15.8	10.0	23.4	13.4	.12	.85
	1926	14.7	8.8	20.2	11.4	.03	.77
	1927	11.0	6.5	17.4	10.9	.19	.99
	1928	11.2	6.4	19.0	12.6	.22	1.12

See footnotes on page 287.

TABLE V (*Continued*). MEDIANS, QUARTILES, SKEWNESS, AND DISPERSION MEASURES FROM YEARLY FREQUENCY DISTRIBUTIONS OF NUMBER OF CORPORATIONS BY EARNINGS RATIOS*

(*Source Book of Industrial Profits Data*)

Major Group	Year	Statistical Measures					
		Medians Md	Lower Quartiles Q_1	Upper Quartiles Q_3	Inter-Quartile Ranges Q_3-Q_1	Skewness $\frac{q_2-q_1}{q_2+q_1}$§	Coefficients of Dispersion $\frac{Q_3-Q_1}{Md}$
No. 10 Metal	†1919	26.1	15.7	41.3	25.6	.19	.98
	1920	18.8	10.4	29.2	18.8	.11	1.00
	1921	4.5	‖	‖	‖	‖	‖
	1922	13.4	6.2	24.4	18.2	.21	1.36
	1923	16.7	10.0	24.5	14.5	.07	.87
	‡1924	11.6	6.4	18.8	12.4	.15	1.07
	1925	14.4	8.4	21.5	13.1	.08	.91
	1926	14.2	7.9	20.8	12.9	.01	.91
	1927	10.9	6.1	17.5	11.4	.15	1.04
	1928	12.4	6.8	19.3	12.5	.11	1.01
No. 11 Scientific Instruments, Toys	†1919	26.7	17.7	37.6	19.9	.09	.74
	1920	17.8	11.5	27.8	16.3	.22	.91
	1921	10.4	3.7	19.1	15.4	.13	1.48
	1922	16.4	11.3	26.4	15.1	.32	.92
	1923	17.3	11.9	25.8	13.9	.22	.80
	‡1924	15.4	9.0	21.6	12.6	−.02	.82
	1925	13.5	9.7	22.9	13.2	.41	.98
	1926	13.7	8.8	21.4	12.6	.21	.92
	1927	12.2	6.9	19.4	12.5	.15	1.02
	1928	10.9	7.0	19.8	12.8	.40	1.17
No. 12 Retail Trade	†1919	36.3	24.2	56.2	32.0	.24	.88
	1920	17.1	9.7	27.4	17.7	.16	1.03
	1921	10.9	5.6	16.8	11.2	.05	1.03
	1922	16.8	10.6	25.0	14.4	.14	.86
	1923	16.4	10.9	22.5	11.6	.05	.71
	‡1924	12.8	8.6	18.5	9.9	.16	.77
	1925	13.6	9.1	18.8	9.7	.06	.71
	1926	12.9	8.6	18.0	9.4	.07	.73
	1927	11.2	6.8	16.5	9.7	.07	.87
	1928	10.8	6.5	16.1	9.6	.10	.89

See footnotes on page 287.

TABLE V (*Continued*). MEDIANS, QUARTILES, SKEWNESS, AND DISPERSION MEASURES FROM YEARLY FREQUENCY DISTRIBUTIONS OF NUMBER OF CORPORATIONS BY EARNINGS RATIOS*

(*Source Book of Industrial Profits Data*)

Major Group	Year	Statistical Measures					
		Medians Md	Lower Quartiles Q_1	Upper Quartiles Q_3	Inter-Quartile Ranges Q_3-Q_1	Skewness $\frac{q_2-q_1}{q_2+q_1}$§	Coefficients of Dispersion $\frac{Q_3-Q_1}{Md}$
No. 13 Wholesale Trade	†1919	24.8	20.4	41.3	21.4	.59	.86
	1920	15.9	6.7	27.7	21.0	.23	1.32
	1921	5.4	.0	11.3	11.3	.04	2.09
	1922	12.1	7.1	18.9	11.8	.15	.97
	1923	12.9	9.1	18.0	8.9	.15	.69
	‡1924	10.1	6.4	13.9	7.5	.01	.74
	1925	9.9	6.0	13.9	7.9	.01	.80
	1926	8.9	5.4	13.3	7.9	.13	.89
	1927	8.8	6.7	12.9	6.2	.34	.70
	1928	8.3	5.1	12.4	7.3	.10	.89
No. 14 Retail and Wholesale Trade	†1919	27.8	20.0	43.2	23.2	.57	.83
	1920	20.5	13.3	33.6	19.8	.32	.96
	1921	8.4	3.2	16.5	13.3	.22	1.59
	1922	14.9	9.1	20.4	11.3	−.26	.76
	1923	14.5	9.7	21.6	11.9	.19	.82
	‡1924	12.2	7.8	18.0	10.2	.12	.84
	1925	11.2	6.9	16.0	9.1	.07	.81
	1926	10.4	6.2	15.4	9.2	.09	.88
	1927	10.2	6.1	13.8	7.7	−.09	.75
	1928	8.9	4.9	13.3	8.4	.05	.94
No. 15 Extractive	†1919	12.7	6.2	25.4	19.2	.32	1.51
	1920	17.2	9.1	35.7	26.6	.39	1.55
	1921	7.3	1.9	15.9	14.0	.23	1.92
	1922	12.0	4.9	21.3	16.4	.13	1.37
	1923	12.3	5.9	21.6	15.7	.18	1.28
	‡1924	9.1	4.5	15.8	11.3	.19	1.24
	1925	11.1	5.5	18.3	12.8	.13	1.15
	1926	11.6	6.5	20.1	13.6	.24	1.17
	1927	10.2	4.5	18.1	13.6	.17	1.33
	1928	10.0	4.2	16.1	11.9	.02	1.13

See footnotes page 287.

TABLE V (*Continued*). MEDIANS, QUARTILES, SKEWNESS, AND DISPERSION MEASURES FROM YEARLY FREQUENCY DISTRIBUTION OF NUMBER OF CORPORATIONS BY EARNINGS RATIOS*
(*Source Book of Industrial Profit Data*)

Major Group	Year	Statistical Measures					
		Medians *Md.*	Lower Quartiles Q_1	Upper Quartiles Q_3	Inter-Quartile Ranges Q_3-Q_1	Skewness $\frac{q_2-q_1}{q_2+q_1}$§	Coefficients of Dispersion $\frac{Q_3-Q_1}{Md}$
No. 16 Banking	†1919	13.1	9.1	19.1	10.0	.20	.76
	1920	12.7	7.8	17.9	10.1	.03	.79
	1921	9.7	6.5	13.5	7.0	.08	.72
	1922	13.8	7.8	17.2	9.4	−.28	.68
	1923	10.6	7.2	14.1	6.9	.01	.65
	‡1924	9.5	6.5	13.7	7.2	.15	.76
	1925	10.3	6.9	13.5	6.6	−.05	.64
	1926	9.9	6.8	14.3	7.5	.14	.76
	1927	9.9	6.7	13.3	6.6	.03	.66
	1928	9.8	6.5	13.2	6.7	.03	.68

* The distributions analyzed are to be found in *A Source Book of Industrial Profits* by Ralph C. Epstein, United States Department of Commerce, Washington, 1932. For the distributions for the years 1919–23 for Major Groups 1 to 11, inclusive, see Table 14, pp. 31–36; for Major Groups 12 to 14 inclusive, see Table 29, pp. 51–52; for Major Group 15 see Table 116, p. 154; and for Major Group 16 see Table 41, p. 57. For the distributions for the years 1924–28 for Major Groups 1 to 11, inclusive, see Table 15 pp. 37–42; for Major Groups 12 to 14, inclusive, see Table 30, pp. 53–54; for Major Group 15 see Table 117, p. 155; and for Major Group 16 see Table 42, p. 57. For the number of corporations in the yearly distributions for each Major Group consult this text, pp. 65–67.

† The distributions for the years 1919–23 are based upon ratios of *total net income* to *capitalization*. For definitions of these terms consult footnote 24, p. 66.

‡ The distributions for the years 1924–28 are based upon ratios of *total profit* to *total capital*. For definitions of these terms consult footnote 25, p. 66.

§ For meaning of this measure, see explanation in text on p. 58.

‖ The lower quartiles could not be computed because they fall in a class interval that has an open end so that certain other measures dependent upon the quartiles could not be obtained.

TABLE VI. MEDIANS, QUARTILES, SKEWNESS, AND DISPERSION MEASURES FROM YEARLY FREQUENCY DISTRIBUTIONS OF NUMBER OF CORPORATIONS AND PERCENTAGES OF TOTAL ASSETS BY EARNINGS RATIOS*

(National Industrial Conference Board Data)

Major Group	Type of Distribution	Year	Statistical Measures						
			Means M	Medians Md	Lower Quartiles Q_1	Upper Quartiles Q_3	Inter-Quartile Ranges Q_3-Q_1	Skewness $\frac{q_3-q_1}{q_3+q_1}$† $M-Md$‡	Coefficients of Dispersion $\frac{Q_3-Q_1}{Md}$
Food	By number of corporations	1922		11.8	5.6	20.0	14.4	+.13	1.30
		1923		10.9	5.4	17.6	12.2	+.10	1.11
		1924		10.5	5.7	17.2	11.5	−.16	1.09
	By percentages of total assets	1922	9.5	8.0	5.4	13.4	8.1	+1.5	1.01
		1923	9.3	7.6	3.9	12.7	8.8	+1.7	1.15
		1924	8.4	7.6	3.7	12.6	8.9	+.8	1.17
Textiles	By number of corporations	1922		13.9	7.6	20.5	12.9	+.23	.93
		1923		11.6	6.9	17.1	10.2	+.08	.88
		1924		6.3	1.6	11.8	10.2	−.08	1.61
	By percentages of total assets	1922	12.9	9.9	5.5	18.2	12.7	+3.0	1.28
		1923	11.0	9.5	6.1	14.3	8.2	+1.5	.86
		1924	4.2	3.7	−1.4	8.7	10.1	+.5	2.73
Leather	By number of corporations	1922		10.3	6.1	19.7	13.6	+.38	1.32
		1923		9.2	4.2	14.6	10.4	+.04	1.13
		1924		6.8	2.0	14.1	12.1	−.21	1.78
	By percentages of total assets	1922	13.9	12.1	6.9	21.6	14.7	+1.8	1.21
		1923	10.7	9.5	6.0	17.0	11.0	+1.2	1.15
		1924	10.5	8.4	5.2	16.8	11.6	+2.1	1.38
Lumber	By number of corporations	1922		14.7	7.9	21.5	13.6	.00	.92
		1923		16.1	9.5	21.0	11.5	−.15	.71
		1924		9.8	4.6	17.0	12.4	−.16	1.26
	By percentages of total assets	1922	9.9	6.5	2.7	13.3	10.6	+3.4	1.63
		1923	12.6	9.8	5.8	17.2	11.4	+2.8	1.16
		1924	7.9	6.0	2.5	10.8	8.3	+1.9	1.38
Paper & Pulp	By number of corporations	1922		11.9	6.3	19.4	13.1	+.15	1.10
		1923		10.7	5.6	16.7	11.1	+.08	1.03
		1924		10.0	4.9	16.2	11.3	−.14	1.13
	By percentages of total assets	1922	8.6	8.4	2.5	13.8	11.3	+ .2	1.34
		1923	7.1	6.0	2.4	11.9	9.5	+1.1	1.58
		1924	8.3	6.5	2.8	10.9	8.1	+1.8	1.24
Printing & Publishing	By number of corporations	1922		18.6	10.9	22.3	11.4	−.35	.61
		1923		15.0	8.2	21.4	13.2	−.03	.88
		1924		13.7	8.5	20.8	12.3	−.15	.90
	By percentages of total assets	1922	16.1	11.3	5.5	27.5	22.0	+4.8	1.95
		1923	12.6	10.5	3.2	21.3	18.1	+2.1	1.72
		1924	11.8	12.4	7.0	17.2	10.2	−.6	.82

TABLE VI (*Continued*). MEDIANS, QUARTILES, SKEWNESS AND DISPERSION MEASURES FROM YEARLY FREQUENCY DISTRIBUTIONS OF NUMBER OF CORPORATIONS AND PERCENTAGES OF TOTAL ASSETS BY EARNINGS RATIOS*

(*National Industrial Conference Board Data*)

Major Group	Type of Distribution	Year	Statistical Measures						
			Means M	Medians Md	Lower Quartiles Q_1	Upper Quartiles Q_3	Inter-Quartile Ranges Q_3-Q_1	Skewness $\frac{q_3-q_1}{q_3+q_1}$ † & $M-Md$ ‡	Coefficients of Dispersion $\frac{Q_3-Q_1}{Md}$
Chemicals	By number of corporations	1922		15.4	9.2	21.5	12.3	−.01	.80
		1923		13.6	7.1	20.8	13.7	−.05	1.00
		1924		11.5	6.1	19.8	13.7	−.02	1.19
	By percentages of total assets	1922	8.1	4.5	2.0	12.7	10.7	+3.6	2.38
		1923	6.1	3.4	1.2	9.8	8.6	+2.7	2.53
		1924	7.3	7.8	5.9	9.7	3.8	−.5	.49
Stone & Clay	By number of corporations	1922		12.4	7.0	20.7	13.7	−.21	1.10
		1923		17.5	11.5	21.9	10.4	−.15	.59
		1924		13.3	8.4	20.0	11.6	−.15	.87
	By percentages of total assets	1922	12.1	10.5	6.8	14.5	7.7	+1.6	.73
		1923	15.8	14.9	11.0	19.6	8.6	+.9	.58
		1924	12.6	11.5	7.8	14.8	7.0	+1.1	.61
Metal	By number of corporations	1922		10.9	4.8	19.7	14.9	+.18	1.36
		1923		13.0	7.2	20.1	12.9	+.10	.99
		1924		9.3	4.7	15.7	11.0	−.16	1.18
	By percentages of total assets	1922	5.5	3.6	1.5	9.1	7.6	+1.9	2.11
		1923	8.7	5.6	2.4	12.7	10.3	+3.1	1.84
		1924	6.8	4.8	2.2	10.7	8.5	+2.0	1.77
Wholesale Trade	By number of corporations	1922		9.3	5.4	14.5	9.1	+.14	.98
		1923		9.5	6.0	13.9	7.9	+.11	.83
		1924		7.2	3.5	11.2	7.7	−.04	1.07
	By percentages of total assets	1922	8.0	6.7	2.5	12.1	9.6	+1.3	1.43
		1923	8.3	8.0	4.7	11.8	7.1	+.3	.87
		1924	6.8	5.9	2.4	9.3	6.9	+.9	1.17
Retail Trade	By number of corporations	1922		12.2	7.4	18.3	10.9	+.12	.89
		1923		11.9	7.6	16.8	9.2	+.06	.86
		1924		10.0	5.9	14.4	8.5	−.03	.85
	By percentages of total assets	1922	12.5	11.7	7.6	17.2	9.6	+.8	.82
		1923	13.2	11.9	8.1	16.3	8.2	+1.3	.69
		1924	11.8	11.1	6.9	16.5	9.6	+.7	.86

* Source: *The Shifting and Effects of the Federal Corporation Income Tax*, Volume I, New York, National Industrial Conference Board, 1928. The distributions of number of corporations by earnings ratios are found in Appendix I, Table 28, pp. 228–229 of the above named volume. The measures recorded here were derived from those distributions. The number of corporations in each of the yearly distributions by groups are noted on page 68. The measures derived from the distributions of percentages of total assets by earnings ratios were computed by the National Industrial Conference Board and are reproduced here from Appendix I, Table 17, p. 203, of the above named volume. For the character of the earnings ratios used see this text pages 67–69.

† This measure was used to compute the skewness for the distributions of number of concerns by earnings ratios since the means of the distributions were unknown. For the meaning of the measure consult page 58 of this text.

‡ This measure of skewness was used for the distributions of percentages of total assets by earnings ratios.

TABLE VII. STATISTICAL MEASURES DERIVED

(*Federal Trade Commission*

Industry	Years	Number of Concerns	Weighted Means	Simple Means	Medians	Skewness	Lower Quartiles	Upper Quartiles	Inter-quartile Ranges
			Mw	*M*	*Md*	*M*−*Md*	Q_1	Q_3	Q_3-Q_1
Shoe Manufacturing	1914	238	15.10†	15.29	13.69	+1.60	7.57	20.52	12.95
	1915	237	15.00	15.33	12.94	+2.39	5.87	21.90	16.03
	1916	238	26.10†	27.46	22.95	+4.51	15.54	34.53	18.99
	1917	238	24.70†	23.42	21.52	+1.90	13.83	31.03	17.20
	1919	341	29.8	29.9	26.2	+3.7	16.4	39.0	22.6
	Av. 1914–17	237		20.39	17.70	+2.69	12.26	25.03	12.77
Tanning	1914	52	12.9†	11.95	10.30	+1.65	5.99	16.71	10.72
	1915	53	16.5†	16.34	14.15	+2.19	6.76	20.47	13.71
	1916	52	33.8†	32.29	26.85	+5.44	19.23	41.81	22.58
	1917	53	25.7†	27.20	21.70	+5.50	17.06	33.25	16.19
	1919	56	29.8†	48.9	32.7	+16.2	17.4	85.3	67.9
	Av. 1914–17	51		21.17	18.30	+2.87	13.81	28.37	14.56
Steel	1915	78	9.6†	12.1	8.8	+3.3	3.2	17.0	13.8
	1916	78	28.6†	51.7	36.6	+15.1	21.8	66.6	44.8
	1917	78	36.4†	56.0	47.5	+8.3	26.0	78.3	52.3
	1918	91	18.6	31.0	18.6	+12.4	9.9	41.4	31.5
	Av. 1915–18	78	23.8	37.8	32.7	+5.1	20.2	48.2	28.0
Wheat Flour Milling	1919	101	13.9	16.5	14.9	+1.6	9.8	20.8	11.0
	1920	105	14.9	11.4	11.6	−.2	2.6	19.8	17.2
	1921	107	1.6	−2.7	−.2	−2.5	−9.2	6.3	15.5
	1922	101	10.9	9.3	8.4	+.9	4.7	13.1	8.4
	Av. 1919–22	108	10.6	8.8	8.7	+.1	3.3	13.1	9.8
Crude Petroleum	1918	134	24.4	18.0	11.2	+6.8	.4	25.0	24.6
	1922	76	5.9†	9.6	.9	+8.7	−5.5	14.1	19.6
	1923	83	7.5†	12.4	2.7	+9.7	−9.0	14.9	23.9
	1924	89	9.7†	12.0	4.8	+7.2	−1.1	21.0	22.1
	1925	90	12.3	16.4	11.3	+5.1	−2.2	25.6	27.8
	Av. 1922–25	76		13.0	6.7	+6.3	−1.3	16.5	17.8
Petroleum Refining	1922	58	9.9	12.4	9.8	+2.6	2.6	17.9	15.3
	1923	60	5.8	3.8	4.1	−.3	−4.4	9.9	14.3
	1924	63	8.2	6.1	7.1	−1.0	.9	11.9	11.0
	1925	63	11.1	7.8	7.9	−.1	3.0	14.8	18.8
	Av. 1922–25	58		7.7	7.8	−.1	2.5	12.7	10.2
Southern Pine Lumber	1917	156	9.0†	11.7	9.7	+2.0	5.6	15.4	9.8
	1918	144	8.4	8.9	7.8	+1.1	3.3	12.2	8.9
Stove Manufacturing	1920	78	15.6	18.2	17.4	+.8	9.2	23.1	13.9
	1921	78	1.1	2.0	.1	+1.9	−5.5	10.7	16.2
Retail Hardware Stores	1920	70	18.4	25.3	18.3	+7.0	14.0	32.1	18.1
	1921	70	2.0	10.9	5.0	+5.9	−3.9	14.5	18.4
Washing Machine Manufacturing	1920	35	24.7	17.0	12.1	+4.9	5.8	26.6	20.8
	1921	35	−.5	−5.9	−5.6	−.3	−14.5	5.5	20.0
Retail Furniture Stores	1920	355	22.0	21.5	18.3	+3.2	11.1	26.3	15.2
	1921	355	8.6	7.0	6.2	+.8	.2	13.0	12.8
Public Utility	1915	96	5.17	5.31	4.99	+.32	3.53	6.57	3.04
	1916	112	5.48	5.41	5.12	+.29	3.79	6.50	2.71
	1917	120	5.22	5.11	4.69	+.42	3.41	5.89	2.48
	1918	142	4.46	4.47	4.31	+.16	2.58	5.70	3.12
	1919	157	5.14	4.96	4.61	+.35	2.94	6.13	3.19
	1920	162	4.94	4.72	4.47	+.25	3.28	5.73	2.45
	1921	171	5.38	5.07	4.98	+.09	3.30	6.41	3.11
	1922	172	6.29	5.99	5.82	+.17	4.33	6.99	2.66
	1923	179	6.45	5.88	5.36	+.52	4.23	6.98	2.75
	1924	172	5.97	5.60	5.32	+.28	3.51	7.07	3.56

For footnotes see page 294.

FROM THE DISTRIBUTIONS BY EARNINGS RATIOS*
and Public Utility Data)

Standard Deviations	Coefficients of Dispersion	Coefficients of Skewness	Modes	Pearsonian Curve Type Criteria					Main Curve Types	Possible Transition Types
σ	σ/M	χ	Mo	β_1	β_2	κ_1	κ_2	r		
15.84	1.04	+.30	10.49	2.0602	10.8230	9.4654	.2801	4.9207	IV	
14.87	.97	+.31	10.65	1.0485	5.9774	2.8093	.3621	8.3912	IV	
19.70	.72	+.70	13.69	4.4584	11.5434	3.7116	1.9357	9.8367	VI	
17.20	.73	+.36	17.14	3.1788	13.8561	12.1758	.4043	4.7688	IV	
19.33	.65	+.68	16.7	1.7874	5.6343	−.0936	−20.7209	−182.4936	I$_I$	III
12.59	1.03	+.75	10.95	1.5773	5.0397	−.6425	−2.5715	−22.9951	I$_I$	III
9.55	.80	+.05	11.49‡	.0367	5.0355	3.9609	.0075	6.0570	IV	VII
13.55	.83	+1.17	.45	3.7710	8.1765	−.9600	−5.7377	−21.2844	J$_I$	J$_{III}$
24.97	.77	+1.21	2.13	5.0010	10.2556	−.4921	−17.1580	−51.8736	J$_I$	J$_{III}$
14.54	.53	+1.29	8.49	3.1415	6.9369	−1.5477	−2.7333	−10.8409	J$_I$	
37.1	.76	+.23	40.19‡	.3511	1.7741	−3.5051	−.0944	−.7241	U$_I$	
12.59	.59	+.63	13.27	2.1307	6.5842	.7763	3.1601	26.6920	VI	III
13.4	1.11	+.75	2.0	1.0758	4.0696	−1.0882	−.9466	−10.9974	I$_I$	III
50.6	.98	+4.45	−173.7	8.2048	12.6520	−5.3104	−3.6395	−3.8948	J$_I$	
36.8	.66	+.50	37.4	1.0127	4.5141	−.0099	−96.1284	−151.6000	I$_I$	III
33.9	1.09	+3.78	−97.3	4.3778	7.6427	−3.8480	−1.8466	−3.5315	J$_I$	
26.3	.70	+1.06	9.8	2.3774	5.9473	−1.2376	−2.3079	−12.4591	J$_I$	
10.2	.62	+.45	11.9	1.1927	5.1974	.8167	1.4253	22.0744	VI	V
14.0	1.23	−.15	13.5	.3567	5.7461	4.4221	.0704	5.9556	IV	VII
16.0	−5.94	−.38	3.3	1.7841	7.7154	4.0785	.4930	7.2546	IV	
11.3	1.21	+.12	8.0	.2677	6.1052	5.4073	.0434	5.3677	IV	VII
8.7	.99	+.15	7.5	.1618	4.0463	1.6072	.0795	10.7677	IV	VII
27.2	1.51	+.46	5.5	2.0367	7.5056	2.9011	.8092	9.2425	IV	V
39.2	4.08	+2.45	−86.3	12.5086	19.4451	−4.6356	−3.4403	−7.6838	J$_I$	
48.7	3.93	+.62	−17.7	4.0484	11.3104	4.4756	1.3992	8.3995	VI	V
29.9	2.49	+.28	3.6	.7284	5.1573	2.1294	.3085	9.6616	IV	
27.9	2.92	+.63	−14.0	5.8016	15.9346	8.4644	1.3252	6.4739	VI	
34.3	2.64	+1.36	−33.8	5.4479	10.6796	−.9845	−9.8161	−25.7899	J$_I$	J$_{III}$
16.0	1.29	+.21	9.1	.5414	5.4415	3.2588	.1470	7.1807	IV	
16.9	4.45	−.02	4.2	.0126	7.3221	8.6064	.0013	4.3987	IV	VII
11.9	1.05	−.26	9.2	.9150	6.3695	3.9940	.2212	6.6918	IV	
10.8	1.38	−.28	10.8	.9717	6.2192	3.5233	.2668	7.2333	IV	
11.2	1.45	−.18	9.7	.5645	6.2617	4.8299	.1073	5.8352	IV	
9.1	.78	+.93	3.2	2.2897	6.0147	−.8397	−3.2200	−19.4712	I$_I$	III
9.1	1.02	+.40	5.3	1.2249	5.6552	1.6357	.7401	12.5829	IV	
14.6	.80	.0	18.2‡	.0000	4.8106	3.6212	.0000	6.3138	IV	VII
14.3	7.27	+.09	.6‡	.0711	3.7248	1.2363	.0443	12.8820	IV	VII
18.6	.73	+1.98	−11.5	3.0446	6.2719	−2.5900	−1.5836	−5.1598	J$_I$	
27.9	2.56	+6.67	−175.2	9.7713	12.7861	−9.7417	−2.8639	−1.2409	J$_I$	
23.8	1.40	+.32	9.4	1.0388	5.8806	2.6448	.3795	8.7155	IV	
17.6	−2.98	−.07	−3.7	.0366	3.6630	1.2162	.0230	12.9571	IV	VII
16.9	.79	+.42	14.3	2.2192	8.4788	4.3000	.6238	7.3390	IV	
14.2	2.03	+.17	4.5	.8149	9.1175	9.7003	.0898	4.4754	IV	
2.93	.55	+.42	4.09	1.5370	6.4382	2.2654	.7146	10.3325	IV	V
2.83	.52	+.48	4.05	2.4771	8.5896	3.7479	.8243	8.1846	IV	V
3.64	.71	+1.35	.17	12.7315	24.2571	4.3197	9.3066	14.6199	J$_{VI}$	
3.84	.86	+.44	2.79	5.3231	20.5768	19.1843	.5814	4.4579	IV	
3.96	.80	+1.38	−.53	9.7646	18.5902	1.8866	1.3883	24.8879	J$_{VI}$	V
3.41	.72	+.38	3.43	2.5321	10.5516	7.5069	.4473	5.6104	IV	
3.62	.71	+.18	4.43	1.0204	9.5335	10.0058	.1141	4.5052	IV	
4.18	.70	+1.18	1.06	9.6128	19.1677	3.4970	6.4389	17.1245	J$_{VI}$	
3.79	.64	+.35	4.55	2.6897	12.1014	10.1337	.3751	4.9804	IV	
3.42	.61	+.61	3.53	4.5953	12.9542	6.1225	1.2552	7.2117	VI	V

For footnotes see page 294.

TABLE VIII. STATISTICAL MEASURES DERIVED FROM THE DIS-

(*Federal Trade Commission*

Industry†	Year	Number of Concerns	Simple Means	Medians	Skewness	Lower Quartiles	Upper Quartiles	Inter-Quartile Ranges	Standard Deviations
			M	Md	$M-Md$	Q_1	Q_3	Q_3-Q_1	σ
Shoe Manufacturing	1914	236	15.20	13.69	+1.51	7.60	20.59	12.99	14.04
	1915	236	15.03	12.91	+2.12	5.89	21.50	15.61	14.17
	1916	237	26.91	22.92	+3.99	15.39	34.26	18.87	17.82
	1917	233	23.21	21.60	+1.61	14.15	31.03	16.88	13.65
	1919	339	29.4	26.3	+3.1	16.4	39.0	22.6	18.31
	Av. 1914–17	236	20.15	17.67	+2.48	12.24	24.94	12.70	12.05
Tanning	1914	51	12.62	10.37	+2.25	6.25	16.85	10.60	8.36
	1915	52	15.22	14.13	+1.09	6.76	19.41	12.65	10.96
	1916	51	29.98	26.73	+3.25	18.99	41.61	22.62	18.91
	1917	52	26.09	21.61	+4.48	17.03	32.79	15.76	12.25
	1919	36	23.3	20.9	+2.4	13.2	30.6	17.4	12.66
	Av. 1914–17	50	20.99	18.07	+2.92	13.75	28.27	14.52	9.83
Steel	1916	72	39.8	34.7	+5.1	21.1	54.1	33.0	23.37
	1917	77	54.1	46.9	+7.2	25.8	76.3	50.5	30.06
	1918	86	24.5	18.1	+6.4	9.6	36.1	26.5	21.13
	Av. 1915–18	75	34.4	30.4	+4.0	20.0	44.2	24.2	20.29
Wheat Flour Milling	1920	104	12.0	11.6	+.4	2.8	20.1	17.3	12.63
	1921	104	−1.9	−1.0	−.9	−8.0	6.3	14.3	13.08
	1922	100	9.8	8.5	+1.3	4.8	13.0	8.2	10.58
Crude Petroleum	1918	127	14.6	10.4	+4.2	.7	22.4	21.7	17.85
	1922	71	2.9	−.1	+3.0	−5.8	12.4	18.2	17.06
	1923	71	1.2	1.7	−.5	−8.9	10.2	19.1	14.10
	1924	88	11.7	4.4	+7.3	−1.8	20.6	22.4	26.30
	1925	82	13.2	10.7	+2.5	−1.2	24.5	25.7	21.36
	Av. 1922–25	69	5.6	4.0	+1.6	1.5	13.1	14.6	13.43
Petroleum Refining	1922	54	10.8	9.7	+1.1	2.6	16.8	14.2	10.62
	1923	58	3.8	3.4	+.4	−4.4	8.5	12.9	12.75
	1924	61	7.5	7.2	+.3	.9	12.0	11.1	9.28
	1925	61	9.0	8.4	+.6	3.3	14.9	11.6	8.55
	Av. 1922–25	56	9.0	8.0	+1.0	2.8	12.8	10.0	8.80
Retail Hardware Stores	1920	67	22.5	18.0	+4.5	13.8	28.9	15.1	13.54
	1921	67	6.4	3.6	+2.8	−4.0	14.1	18.1	15.53
Washing Machine Manufacturing	1920	32	14.5	12.0	+2.5	6.1	25.6	19.5	13.85
	1921	34	−7.4	−5.6	− 1.8	−14.7	−2.1	12.6	15.54
Retail Furniture Stores	1920	350	20.8	18.3	+2.5	11.2	27.9	16.7	28.95
	1921	353	6.5	6.5	+0.0	.3	13.0	12.7	25.89
Public Utility	1915	95	5.39	5.02	+.37	3.58	6.58	3.00	2.87
	1916	111	5.48	5.18	+.30	3.80	6.51	2.71	2.76
	1917	118	4.96	4.66	+.30	3.41	5.88	2.47	2.65
	1918	139	4.29	4.13	+.16	2.58	5.65	3.07	2.53
	1919	154	4.55	4.59	−.04	2.93	5.94	3.01	2.66
	1920	157	4.43	4.41	+.02	3.27	5.65	2.38	2.43
	1921	165	4.74	4.80	−.06	3.29	6.05	2.76	2.36
	1922	166	5.50	5.42	+.08	4.32	6.92	2.60	2.35
	1923	174	5.54	5.35	+.19	4.03	6.92	2.89	2.68
	1924	169	5.31	5.30	+.01	3.51	7.06	3.55	2.59

See footnotes on page 294.

TRIBUTIONS BY EARNINGS RATIOS WITH EXTREMES ELIMINATED*
and Public Utility Data)

Coefficients of Dispersion	Coefficients of Skewness	Modes	Pearsonian Curve Type Criteria					Main Curve Types	Possible Transition Types
σ/M	χ	Mo	β_1	β_2	κ_1	κ_2	r		
.92	+.46	8.58	2.0680	7.5462	2.8884	.8302	9.3025	IV	V
.94	+.50	7.99	.5444	4.7569	1.8806	.2503	10.2494	IV	
.66	+.67	14.93	1.7092	5.5057	−.1162	−15.7447	−144.3976	I	III
.59	+.12	21.54	.3824	7.5870	8.0268	.0492	4.6379	IV	VII
.62	+.60	18.32	1.2742	4.7801	−.2624	−4.8035	−57.2995	I	III
.60	+.58	13.17	1.0875	4.4268	−.4089	−2.5502	−34.3258	I	III
.66	+1.18	2.72	.6150	2.9309	−1.9832	−.2761	−3.9811	I	
.72	+.97	4.55	1.2734	4.1807	−1.4588	−.8721	−7.8447	I	
.63	+2.42	−15.70	.7398	2.8978	−3.4238	−.2005	−2.0293	I	
.47	+1.08	12.81	1.5663	4.5512	−1.5965	−1.0355	−7.4597	I	
.54	+.47	17.37	.3666	3.0230	−1.0538	−.2870	−9.4310	I	
.47	+1.00	11.15	.5894	2.9646	−1.8390	−.2825	−4.4868	I	
.59	+7.57	−137.27	.3889	2.3104	−2.5459	−.1334	−2.1717	I	
.55	+2.00	−6.10	.2112	2.1721	−2.2894	−.0766	−2.5183	I	
.86	+1.25	−.81	1.2081	3.8516	−1.9211	−.6264	−5.1330	I	
.59	+.48	24.65	.7972	4.0679	−.2558	−2.8041	−52.2611	I	III
1.05	+.13	10.37	.0469	2.8247	−.4913	−.0690	−21.7114	I	III or II
6.88	−.27	1.55	.4165	4.0184	.7873	.4424	19.8290	IV	III
1.08	+.22	7.40	.0853	2.8698	−.5163	−.1268	−20.7302	I	III or II
1.22	+.28	9.61	.9562	6.1260	3.3834	.2719	5.6212	IV	
5.88	+.29	−1.99	.2461	3.1592	−.4199	−.4672	−27.3365	I	III or G
11.75	−.07	2.18	.0063	3.3134	.6079	.0077	22.7712	IV	VII or III or G
2.25	+.63	−4.84	1.1691	4.4855	−.5363	−2.1155	−25.9153	I	III
1.62	+.24	8.15	.4081	4.2358	1.2471	.2749	13.6045	IV	
2.40	+.01	5.37‡	.0020	4.0393	2.0726	.0007	8.7927	IV	VII
.98	+.60	4.47	.2025	2.4485	−1.7905	−.0914	−4.1754	I	
3.35	+.15	2.10	.1532	3.7950	1.1304	.1062	14.0134	IV	
1.24	+.37	4.03	.2995	3.0502	−.7941	−.3054	−13.2278	I	III
.95	+.30	6.42	.0958	3.2001	.1128	.6523	111.9309	IV	III
.98	+.93	.78	.6008	3.0207	−1.7610	−.3007	−4.8378	I	
.60	+1.89	−3.05	.9556	3.2728	−2.3212	−.3961	−3.4048	I	
2.43	+.02	6.06‡	.0030	3.3473	.6856	.0003	23.4332	IV	VII or G or III
.95	+1.08	−.50	.2326	2.7340	−1.2298	−.1518	−7.3251	I	
2.10	−.33	−2.35	.1770	2.7421	−1.0468	−.1335	−8.9708	I	
1.39	+.34	−2.59	.6265	3.6277	−.6241	−.8727	−19.2392	I	III
3.98	.00	6.54	.0005	5.3456	4.6897	.0001	5.5591	IV	VII
.59	+.61	3.64	2.0565	6.5066	.8437	2.7734	24.5384	VI	III
.50	+.67	3.61	3.3090	9.0114	2.0958	2.1803	13.4623	VI	
.53	+.75	3.08	3.5928	9.1916	1.6048	3.2385	17.1939	VI	
.59	+.22	3.73	.5925	5.4035	2.9695	.1775	7.7003	IV	
.58	−.19	4.60	.4138	5.0303	2.8192	.1253	7.6969	IV	
.55	+.01	4.41‡	.0008	4.1124	2.2224	.0003	8.4006	IV	VII
.49	−.02	4.78‡	.0037	4.2746	2.5381	.0011	7.7328	IV	VII
.42	.00	5.48‡	.0002	3.2987	.5968	.0002	23.1082	IV	VII or G
.48	+.09	5.29	.0944	4.3983	2.5134	.0297	7.8871	IV	VII
.48	+.08	5.11	.0345	3.3673	.6311	.0414	22.1784	IV	VII

See footnotes on page 294.

Footnotes to Table VII

* For the individual distributions analyzed and the source of each distribution consult Tables I and II in this appendix. The measures in this table were, however, with one exception computed from the *arrays* of the individual items and not from the grouped frequencies. The exception is Retail Furniture Stores where the data were given only in frequency distribution form with class intervals of five per cent. It was these distributions that were used to compute the measures recorded in this table and not the distributions in ten per cent class intervals recorded in Table I. It should be evident, therefore that the grouping of the data for summary presentation in Table I of this appendix did not affect the measures recorded in this table.

† In these cases the weighted means were computed for a slightly smaller or larger number of concerns than was used to compute the unweighted means. These weighted means for all of the industries other than Public Utilities, are taken directly from the reports of the Federal Trade Commission, and the following industrial listing gives the number of concerns used in each instance. For the proper references to the Federal Trade Commission reports, consult Table XII in this appendix

Shoe Manufacturing	237 concerns
Tanning	50 concerns 1914–17, 89 concerns 1919
Steel	86 concerns 1915, 91 concerns 1916, 1917, and 1918
Crude Petroleum	77 concerns 1922, 84 concerns 1923, and 90 concerns in 1924
Southern Pine Lumber	143 concerns in both years

The weighted means for the Public Utility Industry were computed by the writer from the distributions recorded in Table III of this appendix.

‡ In these instances the modes fall between the means and medians. This anomaly arises, with one exception, because the β_1 and χ measure of skewness are small whereas the $M - Md$ measure of skewness is much larger. Since a median is only related to the empirical distribution this is perfectly reasonable. The one exception to this explanation is for the Tanning Industry distribution in 1919 where we have a U-Type curve.

Footnotes to Table VIII

* The distributions analyzed in this table are the same as were examined in Table VII, but certain extreme items were eliminated. The number of items eliminated can be ascertained by comparing the figures for number of concerns in this table with those which appear in Table VII. The particular items eliminated are in italics in Tables I and II. The values recorded here in Table VIII were also computed from the arrays and not from the frequency distributions recorded in Tables I and II.

† Certain distributions which did not present any extreme items, in the sense defined in the text, are not present in this table, since the measures derived would be exactly the same as those recorded in Table VII. The distributions for which this is true are: Steel Industry, 1915; Wheat Flour Millign Industry, 1919 and averages for 1919–22; Southern Pine Lumber Industry, 1917 and 1918; and Stove Manufacturing, 1920 and 1921. Nevertheless, the summary tables in the text which discuss the distributions with extreme items eliminated include these above-mentioned distributions.

‡ See note to Table VII.

TABLE IX. FREQUENCY DISTRIBUTIONS OF NUMBER OF COMPANIES BY DIFFERENCES IN EARNINGS RATIOS BETWEEN SUCCESSIVE YEARS*

(*Public Utility Data*)

1915–1924

Yearly Differences in Earnings Ratios 1% Class Intervals†	Frequencies by Years								
	1915–16	1916–17	1917–18	1918–19	1919–20	1920–21	1921–22	1922–23	1923–24
								(*−30.88*) ‡ (*−11.71*)	
(−10.995)–(−9.995)						*1*			
(− 9.995)–(−8.995)			*1*‡			*1*			
(− 8.995)–(−7.995)			*1*		*1*		*1*		
(− 7.995)–(−6.995)			*1*				*1*		
(− 6.995)–(−5.995)				*1*		*1*			
(− 5.995)–(−4.995)		1	1		1		*1*		
(− 4.995)–(−3.995)		2	2	3	1	1	*1*	1	2
(− 3.995)–(−2.995)		2	4	3	1	1		2	5
(− 2.995)–(−1.995)		9	5	1	10	2		3	11
(− 1.995)–(− .995)	4	17	24	11	16	16	11	17	17
(− .995– .005)	21	40	38	37	51	47	32	59	63
.005– 1.005	58	26	26	55	49	49	68	64	53
1.005– 2.005	7	2	6	14	15	16	30	12	11
2.005– 3.005	1	3	4	7	4	11	9	3	4
3.005– 4.005				4	3	9	3	3	1
4.005– 5.005				2		1	1	1	1
5.005– 6.005	*1*					2	1	1	1
6.005– 7.005			*1*				1	1	
7.005– 8.005		*1*							
8.005– 9.005						*1*	*1*		
9.005– 10.005			*1*				*1*		
10.005– 11.005									*1*
11.005– 12.005									
12.005– 13.005		*1*							
13.005– 14.005							*1* (*28.67*)		
Total frequencies	92	104	115	138	152	159	164	169	170

* The changes in the earnings ratios between the successive years were calculated by taking the earnings ratio in the earlier year from the earnings ratio in the latter year. For source of the original earnings ratios consult the text pages 62–65.

† The class intervals are stated to one more decimal place than the data to give exact class limits.

‡ Italicized frequencies are eliminated for certain computations as explained in the text. Frequencies in parentheses are the exact values of items beyond the convenient limits of the table.

TABLE X. FREQUENCY DISTRIBUTIONS OF NUMBER OF COMPANIES BY

(*Federal Trade*

Yearly Difference in Earnings Ratios 10% Class Intervals†	Shoe Manufacturing			Tanning			Steel		
	1914–15	1915–16	1916–17	1914–15	1915–16	1916–17	1915–16	1916–17	1917–18
								(−202.2)	(−122.6)‡
								(−163.9)	
(−119.995)–(−109.995)			1					1	
(−109.995)–(− 99.995)						1			1
(− 99.995)–(− 89.995)	1‡								2
(− 89.995)–(− 79.995)	1								2
(− 79.995)–(− 69.995)			1					2	
(− 69.995)–(− 59.995)			1					1	4
(− 59.995)–(− 49.995)	1	2				1			5
(− 49.995)–(− 39.995)			6					5	7
(− 39.995)–(− 29.995)	3		10			3		1	3
(− 29.995)–(− 19.995)	5	1	9			6		6	10
(− 19.995)–(− 9.995)	15	7	30	1	1	5		6	17
(− 9.995)– .005	100	26	81	21	2	13	4	6	11
.005 – 10.005	75	84	71	21	22	13	9	11	9
10.005 – 20.005	20	71	18	5	10	5	15	9	2
20.005 – 30.005	11	31	5	1	9	2	14	8	
30.005 – 40.005	1	3	3		4	2	10	6	1
40.005 – 50.005	2	4	2	3	1	1	7	4	1
50.005 – 60.005	1	1			1		5	4	
60.005 – 70.005	1	3			1		4	2	1
70.005 – 80.005		1			1		2		
80.005 – 90.005							2	1	1
90.005 – 100.005		1					2	2	
100.005 – 110.005									
110.005 – 120.005		1							
120.005 – 130.005								1	
130.005 – 140.005									
140.005 – 150.005									
150.005 – 160.005							1		
160.005 – 170.005		1					1		
170.005 – 180.005									
180.005 – 190.005									
190.005 – 200.005									
200.005 – 210.005									
210.005 – 220.005									
220.005 – 230.005									
230.005 – 240.005									
240.005 – 250.005							1		
250.005 – 260.005									
260.005 – 270.005							1		
Total frequencies	237	237	238	52	52	52	78	78	78

* These distributions were obtained by taking the yearly earnings ratios for each company and subtracting the earnings ratio earnings ratios, consult the footnotes to Tables I and II in this appendix.

† Class intervals are expressed to one more decimal place than the original data, so that the class limits are definite.

‡ Italicized frequencies were, as explained in the text, eliminated for certain computations. When a number is in parenthesis

DIFFERENCES IN EARNINGS RATIOS BETWEEN SUCCESSIVE YEARS*
Commission Data)

Petroleum Refining			Crude Petroleum			Southern Pine Lumber	Stove Mfg.	Retail Hardware Stores	Washing Machine Mfg.
1922–23	1923–24	1924–25	1922–23	1923–24	1924–25	1917–18	1920–21	1920–21	1920—21
			(−142.1)	(−188.1)					
					1				
				1					
			1	1					1
2				1	1		1	1	
				3	1			2	2
			1	1					3
	1		2				3	4	6
1		2			4	2	7	4	7
6	1		2	5	2	2	18	15	7
9		4	9	2	7	15	22	18	6
28	18	17	24	16	19	51	20	14	
11	31	31	19	26	30	30	7	7	3
	6	6	9	17	12	10		3	
	2	2	2	3	5				
1		1	1	4	2	1		1	
	1		1						
			1						
				1	1				
			1					1	
				1					
			1		1				
			1		1				
58	60	63	76	83	90	111	78	70	35

n the earlier year from the earnings ratio in the latter year for all successive years. For references as to the source of the original

it indicates a frequency of that value beyond the convenient limits of the table.

TABLE XI. STATISTICAL MEASURES DERIVED FROM THE DISTRIBUTIONS

(Federal Trade Commission

Industry	Years	Number of Concerns	Simple Means	Medians	Skewness	Lower Quartiles	Upper Quartiles	Inter-Quartile Ranges	Standard Deviations
			M	Md	$M-Md$	Q_1	Q_3	Q_3-Q_1	σ
Shoe Manufacturing	1914–15	237	.01	−.63	+.64	−4.99	6.48	11.47	16.22
	1915–16	237	12.22	9.91	+2.31	3.69	17.07	13.38	19.87
	1916–17	238	−4.04	−1.00	−3.04	−9.74	4.84	14.58	17.56
Tanning	1914–15	52	4.43	1.69	+2.74	−3.07	7.41	10.48	12.69
	1915–16	52	15.70	10.88	+4.82	3.84	25.60	21.76	17.29
	1916–17	52	−4.49	−1.40	−3.59	−14.80	8.31	23.11	24.44
Steel	1915–16	78	39.6	27.6	+12.0	13.8	48.9	35.1	46.08
	1916–17	78	4.3	8.5	−4.2	−14.2	34.0	48.2	54.69
	1917–18	78	−23.1	−17.0	−6.1	−46.3	−1.8	44.5	34.29
Crude Petroleum	1922–23	76	2.0	.4	+1.6	−8.0	8.8	16.8	36.40
	1923–24	83	−2.0	2.3	−4.3	−5.4	12.0	17.4	36.32
	1924–25	90	4.5	3.3	+1.2	−3.6	11.4	15.0	32.41
Petroleum Refining	1922–23	58	−8.7	−5.5	−3.2	−14.6	−.9	13.7	16.21
	1923–24	60	2.6	1.9	+.7	−.8	4.9	5.7	10.37
	1924–25	63	1.7	2.1	−.4	−2.0	5.3	7.3	10.99
Southern Pine Lumber	1917–18	111	−2.4	−2.5	+.1	−7.6	2.8	10.4	9.74
Stove Manufacturing	1920–21	78	−16.2	−12.4	−3.8	−24.9	−5.5	19.4	13.01
Retail Hardware Stores	1920–21	70	−14.4	−12.9	−1.5	−24.8	−5.6	19.2	21.92
Washing Machine Mfg.	1920–21	35	−22.9	−23.1	+.2	−34.8	−8.1	26.7	18.04
Public Utility	1915–16	92	.39	.37	+.02	.00	.74	.74	.76
	1916–17	104	−.41	−.24	−.17	−1.13	.14	1.27	1.97
	1917–18	115	−.62	−.36	−.26	−1.30	.15	1.45	2.20
	1918–19	138	.22	.23	−.01	−.21	.89	1.10	1.50
	1919–20	152	−.18	−.03	−.15	−.77	.64	1.41	1.51
	1920–21	159	.29	.09	+.20	−.38	1.01	1.39	2.01
	1921–22	164	.81	.44	+.37	−.04	1.23	1.27	3.04
	1922–23	169	−.18	.02	−.20	−.55	.54	1.09	2.83
	1923–24	170	−.18	−.14	−.04	−.86	.43	1.29	1.63

* These measures were derived from the arrays of the data presented in Tables IX and X and not from the frequency distri-

† In these instances the modes fall between the means and medians, since β_1 and χ are small, while the $M-Md$ is large. See

BY CHANGES IN EARNINGS RATIOS BETWEEN SUCCESSIVE YEARS*
and Public Utility Data)

Coefficients of Dispersion	Coefficients of Skewness	Modes	Pearsonian Curve Type Criteria					Main Curve Types	Possible Transition Types
σ/M	χ	Mo	β_1	β_2	κ_1	κ_2	r		
1622.00	+.18	−2.76	1.0089	11.1099	13.1922	.0919	4.1393	IV	
1.63	+.74	−2.54	8.0435	20.3746	10.6187	1.8036	6.4025	VI	
−4.35	−.36	2.35	2.3241	10.0498	7.1273	.4176	5.6619	IV	
2.87	+1.77	−18.07	3.8356	7.5702	−2.3664	−2.4115	−6.9336	JI	
1.10	+4.65	−64.66	2.9771	5.0728	−4.7857	−.8922	−1.3737	JI	
−4.90	+.24	.95	1.1820	8.2576	6.9692	.1822	5.2307	IV	
1.16	+4.55	−170.02	8.4399	12.9459	−5.4279	−3.7350	−3.8755	JI	
12.72	−.37	24.60	1.5471	7.0083	3.3753	.4907	7.9303	IV	
−1.48	−.03	−22.05†	.0114	4.3742	2.7142	.0003	7.4338	IV	VII
18.20	+.16	−3.94	.8452	11.7097	14.8838	.0033	3.9766	IV	
−18.16	−.39	12.32	2.8725	11.4614	8.3053	.4857	5.4824	IV	
8.10	+.29	−5.01	2.1318	11.5629	10.7304	.2643	4.7143	IV	
−1.87	−.59	.98	3.6846	10.6121	4.1704	1.3036	8.5279	VI	V
3.99	+.06	1.97†	.1301	10.0590	13.7277	.0101	3.9026	IV	VII
6.87	−.14	3.19	.3682	6.2034	5.3022	.0623	5.4715	IV	
−4.06	.00	−2.41†	.0130	5.0457	4.0524	.2577	5.9708	IV	
−.80	−.40	−11.08	1.2761	5.7429	1.6575	.6854	12.5495	IV	V
−1.52	−.18	−10.38	.8028	8.2875	8.1504	.1021	4.7738	IV	
−.78	+.40	−30.29	.3247	3.0393	−.8955	−.2956	−18.1883	II	III
1.95	+.52	.00	5.8210	19.0649	14.6668	.8216	5.0088	IV	V
−4.80	−1.20	1.97	10.7239	21.2714	4.3711	6.8284	13.1054	VI	
−3.55	−.03	−.55†	.0373	9.4891	12.8663	.0030	3.5527	IV	VII
6.82	−.20	.52	.6940	6.7871	5.4922	.1207	5.5639	IV	
−8.39	−.15	.04	.6325	9.1277	10.1579	.6647	4.4272	IV	V
6.93	+.17	−.04	1.0954	11.9372	14.5882	.0942	4.0478	IV	
3.75	+1.83	−4.74	25.7106	46.3588	9.5858	15.0838	12.2983	VI	
−15.72	−7.42	20.79	61.1315	84.3627	−20.6691	−104.3973	−6.4534	JI	
−9.05	−.30	.32	2.6580	14.2413	14.5086	.2779	4.3767	IV	

butions.
similar note to Tables VII and VIII.

TABLE XII. STATISTICAL MEASURES DERIVED FROM THE DISTRIBUTIONS BY CHANGES

(*Federal Trade Commission*

Industry	Years	Number of Concerns	Simple Means	Medians	Skewness	Lower Quartiles	Upper Quartiles	Inter-Quartile Ranges	Standard Deviations
			M	Md	$M-Md$	Q_1	Q_3	Q_3-Q_1	σ
Shoe Manufacturing	1914–15	234	1.07	−.55	+1.62	−4.20	6.50	10.70	13.09
	1915–16	232	11.34	9.74	+1.60	3.80	16.82	13.02	13.80
	1916–17	235	−3.03	−.90	−2.13	−9.35	4.85	14.20	15.00
Tanning	1916–17	50	−1.86	−1.40	−.46	−14.80	8.31	23.11	18.11
Steel	1915–16	74	30.7	26.4	+4.3	13.5	43.3	29.8	23.54
	1916–17	74	9.3	8.8	+.5	12.0	34.0	22.0	35.46
	1917–18	75	−24.3	−17.3	−7.0	−46.0	−5.0	41.0	28.90
Crude Petroleum	1922–23	67	1.1	−.4	+1.4	−6.6	8.1	14.7	12.51
	1923–24	73	4.6	4.1	+.5	−1.8	12.3	14.1	13.36
	1924–25	84	3.3	3.2	+.1	.2	11.1	10.9	15.89
Petroleum Refining	1922–23	55	−7.1	−5.2	−1.9	−11.6	−1.0	10.6	8.98
	1923–24	57	3.1	2.0	+1.1	−.7	4.7	5.4	6.49
	1924–25	61	2.8	2.2	+.6	−1.0	5.4	6.4	8.89
Southern Pine Lumber	1917–18	110	−2.7	−2.5	−.2	−5.8	2.8	8.6	9.12
Stove Manufacturing	1920–21	77	−15.5	−12.4	−3.1	−24.9	−5.4	19.5	12.39
Retail Hardware Stores	1920–21	65	−14.3	−12.8	−1.5	−24.3	−5.8	18.5	14.56
Washing Machine Mfg.	1920–21	34	−21.5	−22.0	+.5	−34.0	−7.4	26.6	16.40
Public Utility	1915–16	91	.34	.37	−.03	.00	.71	.71	.67
	1916–17	102	−.61	−.26	−.35	−1.15	.14	1.29	1.31
	1917–18	110	−.57	−.35	−.22	−1.18	.15	1.33	1.44
	1918–19	137	.27	.24	+.03	−.17	.89	1.06	1.43
	1919–20	151	−.12	−.01	−.11	−.76	.64	1.30	1.36
	1920–21	155	.41	.13	+.28	−.36	1.02	1.38	1.48
	1921–22	156	.63	.44	+.19	−.01	1.14	1.15	1.22
	1922–23	167	.08	.02	+.06	−.54	.54	1.08	1.25
	1923–24	169	−.24	−.14	−.10	−.85	.43	1.28	1.41

* These measures were derived from the same data as were analyzed in Table XI, but with certain extreme items eliminated. tributions are included in the summary tables of this material for the text discussion.

† See similar note to Table XI.

IN EARNINGS RATIOS BETWEEN SUCCESSIVE YEARS WITH EXTREMES ELIMINATED* *and Public Utility Data*)

Coefficients of Dispersion	Coefficients of Skewness	Modes	Pearsonian Curve Type Criteria					Main Curve Types	Possible Transition Types
σ/M	χ	M_0	β_1	β_2	κ_1	κ_2	r		
12.23	+.23	−2.00	.5925	5.2543	2.7311	.1921	8.0410	IV	
1.22	+.39	5.92	1.7116	7.2846	3.4344	.5490	7.9892	IV	V
4.95	−.11	1.39	.1372	4.3666	2.3516	.0228	8.2652	IV	
9.74	−.12	.28	.0525	3.0305	−.0965	−.4134	−122.9845	I_I	III or G
.77	+100.71	−2340.04	1.1468	3.1696	−3.1012	−.3809	−1.9788	J_I	
3.81	+.01	9.04†	.0000	2.1576	−1.6849	−.0001	−4.1284	I_I	II
1.19	−.33	−14.93	.3224	3.2813	−.4046	−.6191	−29.0494	I_I	III
11.37	+.32	−2.91	.5194	4.0132	.4682	.9411	31.9581	IV	V
2.90	+.09	3.39	.0531	3.5399	.9205	.0411	16.2095	IV	VII
4.81	+.02	2.95	.0059	3.9631	1.9085	.0024	9.2969	IV	VII
1.26	−.85	.47	.4755	2.8458	−1.7349	−.2352	−4.7391	I_I	
2.09	+.65	−1.13	1.1213	4.3353	−.6933	−1.5665	−19.1605	I_I	III
3.18	+.17	1.34	.5294	6.5739	5.5596	.0883	5.4441	IV	
3.38	−.11	−1.68	.1220	4.1217	1.8774	.0515	9.5868	IV	
.80	−.41	−10.43	.1620	2.5398	−1.4064	−.0914	−5.8778	I_I	
1.02	−.06	−13.36†	.0080	2.5825	−.8590	−.0007	−9.8801	I_I	II
.76	+.36	−27.31	.0379	2.1253	−1.8631	− .0159	−3.5019	I_I	II
1.97	.00	.34†	.0003	5.4136	4.8263	.0000	4.8913	IV	VII
−2.14	−.09	−.48†	.2229	7.0237	7.3787	.0277	5.2590	IV	
−2.52	−.28	−.16	.5462	4.9416	2.2446	.2116	9.0762	IV	
5.29	+.09	.15	.1277	5.4355	4.4879	.0237	5.7559	IV	
−11.33	−.15	.08	.3359	5.3725	3.7373	.0769	6.4805	IV	
3.60	+.21	.09	.4129	4.5715	1.9043	.1823	9.9520	IV	
1.93	+.51	.01	2.3298	7.5594	2.1294	1.3119	11.0177	VI	V
17.85	+.68	−.78	1.8816	5.8263	.0078	266.0316	2265.1538	VI	III
−5.87	−.01	−.22†	.0025	5.6339	5.2603	.0004	5.2827	IV	VII

Two of the distributions for the Tanning Industry are not included here, since no items were eliminated, but these two dis-

Table XIII. Rate of Earnings on Investment and Size of Investment for Different Industries

(Federal Trade Commission Data)

(The titles of the various reports from which these data have been taken are given in Table I of this Appendix. The references at the bottom of each section of the table give the abbreviated titles of the reports and the specific pages on which the data appear. The tables are not, however, in exactly the same form as in the reference volumes.)

Shoe Manufacturing Industry[1]

Group	Number of Companies	Rates of Return on Investments in Percentages				Number of Companies	Rate of Profit on Total Investments in Percentages	
		1914	1915	1916	1917		1918	1919
Under $100,000	85	12.8	14.6	31.5	26.5	72	16.4	29.7
$100,000–$250,000	56	16.7	15.8	25.2	22.5	90	18.3	31.6
$250,000–$1,000,000	74	15.5	15.2	26.6	25.0	129	14.7	30.3
$1,000,000–$3,000,000	14	15.0	15.5	26.3	20.3	32	17.4	29.8
Over $3,000,000	8	14.7	14.6	25.4	26.3	18	16.2	29.3
Totals	237	15.1	15.0	26.1	24.7	341	16.2	29.8
If allowance made for short term borrowed capital	237	11.0	11.7	20.0	17.4	341	16.2	29.8

Tanning Industry[2]

Group	Number of Companies	Rates of Return on Investments in Percentages				Number of Companies	Rate of Profit on Total Investments in Percentages	
		1914	1915	1916	1917		1918	1919
Under $100,000		9.7	15.7	24.0	32.6	42	18.6	51.4
$100,000–$250,000		13.6	23.5	26.6	34.4	20	18.0	30.3
$250,000–$1,000,000		12.4	16.0	30.4	29.3	12	19.1	47.3
Over $1,000,000		12.8	16.4	34.6	25.4	15	11.0	24.5
Total	50	12.9	16.5	33.8	25.7	89	13.1	29.8
If short term borrowed capital is included	50	5.9	7.7	17.9	13.2	89	13.1	29.8
Sole Leather Tanners						32	9.7	18.9
Upper Leather Tanners						35	13.0	23.8
Kid Leather Tanners						22	26.8	81.0
Total						89	13.1	29.8

[1] *Report on Leather and Shoe Industries*, 1919, p. 104; and *Report on Shoe and Leather Cost and Prices*, 1921, Appendix Table 31, p. 194 and footnote on p. 105.

[2] *Ibid.*, 1919, p. 28. Also *ibid.*, 1921, Table 38 on p. 84, and footnote on p. 84.

TABLE XIII (*Continued*). RATE OF EARNINGS ON INVESTMENT AND SIZE OF INVESTMENT FOR DIFFERENT INDUSTRIES

(*Federal Trade Commission Data*)

Steel Industry[3]

Group	1915		1916		1917		1918	
	Number of Companies	Rates of Return in Percentages	Number of Companies	Rates of Return in Percentages	Number of Companies	Rates of Return in Percentages	Number of Companies	Rates of Return in Percentages
Under $300,000	9	18.3	7	63.4	6	25.8	4	46.4
$300,000–$1,000,000	29	7.7	30	57.5	23	64.6	20	40.5
$1,000,000–$3,000,000	16	17.7	19	47.8	21	60.0	20	39.1
$3,000,000–$10,000,000	12	12.0	16	38.7	21	45.8	23	22.5
$10,000,000–$30,000,000	5	7.6	6	29.8	11	43.8	13	25.5
$30,000,000–$100,000,000	7	9.2	7	25.4	6	30.9	8	19.3
Over$100,000,000	—	—	1	21.4	3	33.0	3	13.3
Total	78	9.6	86	28.6	91	36.4	91	18.6
Steel Corporation (Average Investment 4 years—$2,090,338,329)		6.8		18.6		24.6		21.2

Wheat Flour Milling Industry[4]

Group	1919		1920		1921		1922	
	Number of Companies	Rates of Return in Percentages	Number of Companies	Rates of Return in Percentages	Number of Companies	Rates of Return in Percentages	Number of Companies	Rates of Return in Percentages
		True Av.		True Av.		True Av.		True Av.
Under $250,000	22	18.6	18	1.6	24	−5.4	24	8.4
$250,000–$500,000	26	14.8	30	9.9	30	.1	28	10.2
$500,000–$1,000,000	22	18.0	21	16.4	23	−2.6	22	11.5
$1,000,000–$2,000,000	14	15.5	18	13.7	12	−.4	13	7.1
$2,000,000 and over	17	12.9	18	15.5	18	2.8	14	11.6
Total	101	13.9	105	14.9	107	1.6	101	10.9

Petroleum Refining Industry[5]

Group	1922		1923		1924	
	Number of Companies	Rates of Return in Percentages	Number of Companies	Rates of Return in Percentages	Number of Companies	Rates of Return in Percentages
Petroleum Investment						
Under $1,000,000	10	7.4	9	−14.2	11	−6.3
$1,000,000–$5,000,000	9	15.2	11	12.3	11	11.0
$5,000,000–$25,000,000	12	11.7	11	3.5	10	9.8
$25,000,000–$100,000,000	15	9.7	17	3.6	17	6.8
$100,000,000 and over	12	9.8	12	6.7	14	8.6
Total	58	9.9	60	5.8	63	8.2

[3] *Report on War-Time Profits in the Steel Industry*, Table 5, p. 35.
[4] *Report on Wheat Flour Milling Industry*, pp. 36–37.
[5] *Report on Petroleum Industry*, 1927, pp. 296–297.

TABLE XIII (*Continued*). RATE OF EARNINGS ON INVESTMENT AND SIZE OF INVESTMENT FOR DIFFERENT INDUSTRIES

(*Federal Trade Commission Data*)

Crude Petroleum[6]

Group	1922		1923		1924		1925	
	Number of Companies	Rates of Return in Percentages	Number of Companies	Rates of Return in Percentages	Number of Companies	Rates of Return in Percentages	Number of Companies	Rates o Return in Percentages
Under $1,000,000	51	1.6	55	8.3	58	14.3	56	13.4
$1,000,000–$5,000,000	13	6.6	15	4.3	19	7.1	22	16.4
$5,000,000–$25,000,000	9	10.7	8	23.2	6	24.4	5	51.9
$25,000,000 and over	4	3.7	6	3.7	7	7.8	7	15.5
Total	77	5.9	84	7.5	90	9.7	90	18.6

Southern Pine Lumber[7]

Group	1917		1918	
	Number of Companies	Rates of Return in Percentages	Number of Companies	Rates of Return in Percentages
Under $250,000	14	18.0	14	7.9
$250,000–$500,000	17	14.2	18	10.3
$500,000–$1,000,000	36	14.7	37	11.6
$1,000,000–$2,500,000	46	16.1	35	11.8
$2,500,000–$5,000,000	19	10.7	28	12.4
$5,000,000–$10,000,000	8	8.7	9	9.3
Over $10,000,000	3	5.9	2	7.7
Total	143	11.6	143	10.9

Retail Furniture Stores[8]

Rate of Return 5% Class Intervals	1920				
	Investment under $100,000	Investment $100,000–$300,000	Investment $300,000–$500,000	Investment over $500,000	Total number all classes
over −25.0	1				1
(−24.9)–(−20.0)					
(−19.9)–(−15.0)	2				2
(−14.9)–(−10.0)	3				3
(− 9.9)–(− 5.0)	1	1			2
(− 4.9)– 0.0	2	2			4
0.0 – 4.9	15	8			23
5.0 – 9.9	12	17	7	3	39
10.0 – 14.9	31	25	6	2	64
15.0 – 19.9	29	19	4	7	59
20.0 – 24.9	20	23	7	3	53
25.0 – 29.9	12	11	1		24
30.0 – 34.9	5	8	1	1	15
35.0 – 39.9	8	8	1	2	19
40.0 – 44.9	12	4	1	1	18
45.0 – 49.9	5	3			8
50.0 and over	11	5	1	4	21
Total	169	134	29	23	355
Average Profit (percentages)	20.6	20.8	18.9	25.0	22.0
Medians (*Md*)	19.34	18.63	16.82	19.60	
Lower Quartiles (Q_1)	10.95	11.05	9.71	15.48	
Upper Quartiles (Q_3)	36.04	27.45	23.35	38.05	
Coefficients of Skewness (q_2-q_1/q_2+q_1)	.33	.07	−.04	.63	

[6] *Op. cit.*, p. 278. The earnings rates here recorded were calculated after the deduction of discovery value and other appreciation, and after adding to net income depletion charged on appreciation values.

[7] *Report on War-Time Profits of Southern Pine Lumber Companies*, p. 29.

[8] *Report on House Furnishings Industries*, Vol. I, 1923, Table 26, p. 99.

TABLE XIII (*Continued*). RATE OF EARNINGS ON INVESTMENT AND SIZE OF INVESTMENT FOR DIFFERENT INDUSTRIES

(*Federal Trade Commission Data*)

Retail Furniture Stores[8]

Rate of Return 5% Class Intervals	1921				
	Investment under $100,000	Investment $100,000–$300,000	Investment $300,000–$500,000	Investment over $500,000	Total number all classes
over −25.0	5	1			6
(−24.9)–(−20.0)	3	1			4
(−19.9)–(−15.0)	6				6
(−14.9)–(−10.0)	5	4		1	10
(− 9.9)–(− 5.0)	7	7	1	1	16
(− 4.9)–(0.0)	18	20	2	1	41
0.0 – 4.9	28	31	9	5	73
5.0 – 9.9	30	30	10	5	75
10.0 – 14.9	29	17	5	4	55
15.0 – 19.9	16	12	1	1	30
20.0 – 24.9	8	4		1	13
25.0 – 29.9	6	1			7
30.0 – 34.9	3	3		2	8
35.0 – 39.9	3		1	1	5
40.0 – 44.9					
45.0 – 49.9	1	2			3
50.0 and over	1	1		1	3
Total	169	134	29	23	355
Average Profit	6.4	6.3	7.0	12.3	8.6
Medians (*Md*)	6.70	5.45	6.20	7.45	
Lower Quartiles (Q_1)	−3.90	.13	2.30	2.80	
Upper Quartiles (Q_3)	13.85	11.55	9.82	14.00	
Coefficients of Skewness (q_3-q_1/q_3+q_1)	−.19	.07	−.04	.17	

Table XIV. Association between Size of Investment and Size of Earnings Ratio*

Average Earning Rates for all Companies for 20-Year Period

	Size Group						
	1	2	3	4	5	6	7
Investment Size in millions	Under 2	2–5	5–10	10–25	25–50	50–100	over 100
All Companies	11.6%	9.2%	9.3%	8.8%	9.4%	9.8%	9.5%

Average Earning Rates by Industries for 20-Year Period

Industrial Classification	Size Group						
	1	2	3	4	5	6	7
Iron and Steel	11.2%	8.0%	7.8%	7.8%	7.1%	8.9%	7.1%
Automobiles	18.5	13.6	17.4	14.5	14.1	9.8	17.9
Chemicals	24.5	20.4	11.8	10.7	8.0	7.2	17.3
Petroleum	18.7	10.6	11.5	10.3	11.3	10.9	11.7
Miscellaneous	12.3	8.9	8.9	9.1	8.1	9.3	9.3
Textiles	7.8	8.0	8.4	7.6	6.8	4.9	1.0
Machinery	8.0	6.5	9.4	7.5	6.7	7.4	9.3
Hardware	11.2	11.0	8.7	8.8	19.8	12.7	12.7
Food-stuffs	9.8	9.2	9.1	8.3	10.7	8.0	7.6

Comparative Earning Rates, Large and Small Companies, 20-Year Period

Industrial Classification	With Dividing Point Set at Investment of							
	$25,000,000		$10,000,000		$5,000,000		$2,000,000	
	Small	Large	Small	Large	Small	Large	Small	Large
All Companies	9.5%	9.4%	9.8%	9.3%	10.1%	9.2%	11.6%	9.2%
Iron and Steel	8.2	7.7	8.4	7.7	8.9	7.7	11.2	9.8
Automobiles	15.5	13.4	16.9	14.0	15.3	14.9	18.5	14.5
Petroleum	11.4	11.3	11.6	10.5	12.4	11.1	18.7	10.8
Chemicals	14.9	9.0	16.5	9.8	22.4	10.5	24.5	12.0
Textiles	8.0	5.6	8.0	7.2	7.9	7.7	7.8	7.7
Machinery	7.6	7.1	7.8	7.6	7.0	7.8	7.0	7.4
Foods	8.9	9.3	9.5	8.6	9.4	8.8	9.8	8.9
Hardware	9.9	15.8	10.4	10.9	11.1	10.2	11.2	10.5
Miscellaneous	9.5	8.6	9.6	8.8	10.1	8.9	12.3	8.9

* Source: "A Comparison of the Rates of Earnings of Large-Scale and Small-Scale Industries," *Quarterly Journal of Economics*, May 1932, pp. 476, 477, and 479.

Table XV. Frequency Distributions of Number of Companies by Cost in Dollars per Unit of Output*

Pacific Coast Crude Petroleum			Southern Pine Lumber Industry			Wheat Flour Milling Industry				
Cost per Bbl. in Dollars	1914	1918	Cost of Sales per 1000 feet	1917	1918	Cost per Bbl. in Dollars	1919	1920	1921	1922
$.0005–$.2005	11	1	$11.505–$13.005	4		$4.505–$5.005			1	5
.2005– .4005	31	16	13.005– 14.505	22		5.005– 5.505				28
.4005– .6005	26	28	14.505– 16.005	41	2	5.505– 6.005				26
.6005– .8005	12	30	16.005– 17.505	46	6	6.005– 6.505			10	24
.8005–1.0005	9	18	17.505– 19.005	40	15	6.505– 7.005			9	14
1.0005–1.2005		16	19.005– 20.505	21	24	7.005– 7.505			16	2
1.2005–1.4005	2	10	20.505– 22.005	12	33	7.505– 8.005			7	2
1.4005–1.6005		4	22.005– 23.505	3	29	8.005– 8.505			10	1
1.6005–1.8005	3	1	23.505– 25.005		27	8.505– 9.005			19	
1.8005–2.0005	2	2	25.005– 26.505		25	9.005– 9.505	1	1	13	
2.0005–2.2005		1	26.505– 28.005		11	9.505–10.005	19	5	7	
2.2005–2.4005		2	28.005– 29.505		5	10.005–10.505	35	11	5	
2.4005–2.6005			29.505– 31.005		4	10.505–11.005	29	18	5	
2.6005–2.8005		1	31.005– 32.505		5	11.005–11.505	11	14	4	
2.8005–3.0005		1	32.505– 34.005		1	11.505–12.005	6	23	1	
3.0005–3.2005			34.005– 35.505		1	12.005–12.505		18		
3.2005–3.4005			35.505– 37.005			12.505–13.005		10		
3.4005–3.6005			37.005– 38.505		1	13.005–13.505		4		
3.6005–3.8005						13.505–14.005				
3.8005–4.0005						14.005–14.505		1		
4.0005–4.2005		1								
4.2005–4.4005										
4.4005–4.6005		1								
4.6005–4.8005										
4.8005–5.0005										
5.0005–5.2005										
5.2005–5.4005		1								
Totals	96	134		189	189		101	105	107	102
Means† (*M*)	$.546	$.930		$16.99	$23.11		$99.9	$11.02	$8.38	$5.93
Medians† (*Md*)	.422	.757		16.75	22.89		9.97	11.09	8.51	5.87
Skewness† (*M* − *Md*)	+.124	+.173		+.24	+.22		+.02	−.07	−.23	+.06

* All of these costs data are taken from reports of the Federal Trade Commission. The following titles give the reports utilized and the specific page references:
Pacific Coast Petroleum Industry, Part I, 1921; Tables 39 and 43 on pages 252 and 259, respectively.
War-Time Costs and Profits of Southern Pine Lumber Companies, 1922; Tables 42 and 43 on pages 84 to 89, inclusive.
Wheat Flour Milling Industry, 1924; Tables 7 and 8 on pages 113 and 114.

† These measures were computed from the arrays and not from the distributions recorded above.

TABLE XVI. FREQUENCY DISTRIBUTION OF 2,046 MANUFACTURING CORPORATIONS AND 664 TRADING CORPORATIONS BY PERCENTAGES OF TOTAL PROFITS TO TOTAL CAPITAL, WITHIN TOTAL CAPITAL CLASSES, 1924 AND 1928*

1924

Major Group	Rate of Total Profit to Total Capital	Under $500,000	$500,000 to $999,999	$1,000,000 to $2,499,999	$2,500,000 to $4,999,999	$5,000,000 to $24,999,999	$25,000,000 to $49,999,999	$50,000,000 and Over	Total All Capital Classes
1 to 11 inc.	Under Zero	4	8	8	8	23	5	3	59
	Zero to 4%	18	31	50	30	55	10	11	205
	5 to 9%	35	83	133	90	96	15	24	476
	10 to 14%	43	104	141	65	64	18	16	451
	15 to 19%	36	90	106	53	43	4	3	335
	20 to 24%	26	57	60	28	19	5	9	204
	25 to 29%	20	28	36	17	9	5		115
	30% and over	48	60	62	18	7	6		201
	Total	230	461	596	309	316	68	66	2046
	Medians (*Md*)	16.65	14.75	13.30	9.70	8.65	10.60	8.45	
	Lower Quartiles (Q_1)	9.55	9.10	7.95	6.65	5.00	5.20	5.00	
	Upper Quartiles (Q_3)	27.00	22.10	20.25	18.15	14.40	18.70	13.10	
	Coefficients of Skewness†	.19	.19	.05	.51	.30	.20	.15	
12 to 14 inc.	Under zero	3	3	1	4	1			12
	Zero to 4%	10	16	19	8	4	1		58
	5 to 9%	18	58	59	20	15	2	1	173
	10 to 14%	35	80	62	17	17	3	3	217
	15 to 19%	22	33	30	9	6			100
	20 to 24%	7	13	18	4	1	1	2	46
	25 to 29%	6	12	9	1	2		1	31‡
	30% and over	6	10	6	3	2			27‡
	Total	107	225	204	66	48	7	7	664
	Medians (*Md*)	12.15	12.10	11.35	9.75	10.70	10.30	8.65	
	Lower Quartiles (Q_1)	7.75	8.15	7.15	5.60	6.80	6.40	5.75	
	Upper Quartiles (Q_3)	16.75	16.75	16.50	14.80	14.20	14.05	22.60	
	Coefficients of Skewness†	.02	.03	.10	.10	−.05	−.02	.65	

TABLE XVI (*Continued*). FREQUENCY DISTRIBUTION OF 2,046 MANUFACTURING CORPORATIONS AND 664 TRAINING CORPORATIONS BY PERCENTAGES OF TOTAL PROFITS TO TOTAL CAPITAL, WITHIN TOTAL CAPITAL CLASSES, 1924 AND 1928*

1928

Major Group	Rate of Total Profit to Total Capital	Under $500,000	$500,000 to $999,999	$1,000,000 to $2,499,999	$2,500,000 to $4,999,999	$5,000,000 to $24,999,999	$25,000,000 to $49,999,999	$50,000,000 and Over	Total All Capital Classes
	Class Interval								
1 to 11 inc.	Under Zero	1	5	16	14	28	7	5	76
	Zero to 4%	19	47	73	35	69	11	12	266
	5 to 9%	42	96	162	84	100	13	23	520
	10 to 14%	44	84	129	89	87	16	22	471
	15 to 19%	30	62	83	58	49	9	7	298
	20 to 24%	9	40	68	33	16	5	8	179
	25 to 29%	10	18	35	12	13	3	2	93
	30% and over	32	24	40	26	14	3	4	143
	Total	187	376	606	351	376	67	83	2046
	Medians (*Md*)	13.05	11.90	11.50	11.65	9.05	10.25	9.85	
	Lower Quartiles (Q_1)	7.65	6.70	6.40	6.80	4.75	4.45	5.30	
	Upper Quartiles (Q_3)	21.85	17.70	19.00	18.00	14.40	16.30	14.65	
	Coefficients of Skewness†	.24	.05	.19	.13	.11	.02	.03	
12 to 14 inc.	Under Zero	1	2	5	1	2	1	1	13
	Zero to 4%	20	31	30	10	12	1		104
	5 to 9%	28	69	80	23	20	4	1	225
	10 to 14%	20	48	71	24	14	3	3	183
	15 to 19%	11	19	28	13	6	2	1	80
	20 to 24%	5	13	9	3	1		1	32
	25 to 29%	2	1	5	4	2	1	1	16
	30% and over	3	4	3	1				11
	Total	90	187	231	79	57	12	8	664
	Medians (*Md*)	8.75	8.85	9.50	10.65	8.12	9.50	12.80	
	Lower Quartiles (Q_1)	4.75	5.55	5.90	6.40	4.56	5.75	9.50	
	Upper Quartiles (Q_3)	14.10	13.50	13.60	19.30	12.60	14.50	19.50	
	Coefficients of Skewness†	.14	.17	.06	.34	.11	.14	.34	

* Material was gathered from *Source Book of Industrial Profits*, Tables 118, 119, 122, and 123 on pp. 156–160.
† Bowley measure. For description see p. 58.
‡ These two figures differ from those recorded in the *Source Book* since there is obviously a typographical error in the *Source Book* tables.

TABLE XVII. TWO-WAY FREQUENCY TABLES ILLUSTRATIVE OF THE RATES OF EARNINGS IN ONE YEAR AND CHANGES IN RATES BETWEEN THAT YEAR AND THE SUCCEEDING YEAR

(*Federal Trade Commission Data*)

Steel Industry

Earning Rates 1915	Change in Earning Rates 1915 to 1916																					Total
	−9 to 0	0 to 9	10 to 19	20 to 29	30 to 39	40 to 49	50 to 59	60 to 69	70 to 79	80 to 89	90 to 99			150 to 159	160 to 169			240 to 249	250 to 259	260 to 269		
−19 to −10				1		1																2
−9 to 0				2	2		1			1												6
0 to 9	1	5	10	4	4	2	1	2	1	1	1			1								33
10 to 19	1	2	4	3	4	1	2	2														19
20 to 29	1	2	1	3		1	1								1					1		11
30 to 39				1		1																2
40 to 49						1			1									1				3
50 to 59	1										1											2
Total	4	9	15	14	10	7	5	4	2	2	2			1	1			1	0	1		78

Tanning Industry

Earning Rates 1916	Change in Earning Rates 1916 to 1917																Total
	−100 to 100			−59 to −50	−49 to −40	−39 to −30	−29 to −20	−9 to −10	−9 to −0	0 to 9	10 to 19	20 to 29	30 to 39	40 to 49			
0 to 9									3	4	2	1	1				8
10 to 19									4	1							8
20 to 29								1	6	4	2		1	1			15
30 to 39							2	1	3	1							7
40 to 49							2	2	1								5
50 to 59						1		1				1					3
60 to 69						1	2										3
70 to 79				1		1											2
150 to 159	1																1
Total	1			1	0	3	6	5	13	13	5	2	2	1			52

TABLE XVII (*Continued*). TWO-WAY FREQUENCY TABLES ILLUSTRATIVE OF THE RATES OF EARNINGS IN ONE YEAR AND CHANGES IN RATES BETWEEN THAT YEAR AND THE SUCCEEDING YEAR

(*Federal Trade Commission Data*)

Crude Petroleum

Earning Rates 1924	Change in Earning Rates 1924 to 1925																									Total
	−119 to −110	−79 to −70	−69 to −60	−59 to −50	−49 to −40	−39 to −30	−29 to −20	−19 to −10	−9 to 0	0 to 9	10 to 19	20 to 29	30 to 39	40 to 49	50 to 59	60 to 69	70 to 79	130 to 139	140 to 149	150 to 159	160 to 169					
−79 to −70											1															1
−49 to −40							1																			1
−39 to −30										1	1			1												3
−29 to −20	1								1	2	1			1												1
−19 to −10									6	6	2	2		1		1										5
−9 to 0							1																			19
0 to 9							1	2	5	13	3	1														25
10 to 19			1						4	4	2															11
20 to 29								1	1	2	2	1														7
30 to 39							1	1	2	2			1													7
40 to 49																										0
50 to 59							1	1																		2
60 to 69		1																								1
70 to 79								2			1		1													4
80 to 89																			1							1
90 to 99							1																			1
100 to 109																										0
110 to 119																					1					1
Total	1	1	1	0	0	4	2	7	19	30	12	5	2	3	0	0	1		1	0	0	1				90

TABLE XVIII. TWO-WAY FREQUENCY TABLES ILLUSTRATIVE OF CHANGES IN EARNINGS RATIOS BETWEEN SUCCESSIVE YEARS AND PERCENTAGE CHANGES IN TOTAL ASSETS BETWEEN THOSE YEARS

(Public Utility Data)

Percentage Change in Total Assets 1917–18	Change in Earnings Ratio 1917–1918																							Total
	−9.9 to −9	−8.9 to −8	−7.9 to −7	−6.9 to −6	−5.9 to −5	−4.9 to −4	−3.9 to −3	−2.9 to −2	−1.9 to −1	−.9 to 0	.0 to .9	1.0 to 1.9	2.0 to 2.9	3.0 to 3.9	4.0 to 4.9	5.0 to 5.9	6.0 to 6.9					9.0 to 9.9	
−52.9 to −49.0																						1		1
−11.9 to −8.0											1													1
−7.9 to −4.0									1															1
−3.9 to 0.0		1					1	3	3	4	4	1												17
0.0 to 3.9						1	3	1	9	22	13	2												51
4.0 to 7.9						1			6	6	4	1												18
8.0 to 11.9									3	2	1	1	3											10
12.0 to 15.9										2	1	1												4
16.0 to 19.9																								0
20.0 to 23.9											1													1
24.0 to 27.9																	1							1
28.0 to 31.9	1							1																3
32.0 to 35.9			1																					1
36.0 to 39.9																								0
40.0 to 43.9										1														1
52.0 to 55.9										1														1
68.0 to 71.9									1															1
80.0 to 83.9									1															1
212.0 to 215.9					1																			1
Total	1	1	1	0	1	2	4	5	24	38	25	6	4	0	0	0	1					1		114

TABLE XVIII (*Continued*). TWO-WAY FREQUENCY TABLES ILLUSTRATIVE OF CHANGES IN EARNINGS RATIOS BETWEEN SUCCESSIVE YEARS AND PERCENTAGE CHANGES IN TOTAL ASSETS BETWEEN THOSE YEARS

(*Public Utility Data*)

| Percentage Change in Total Assets 1921–22 | Change in Earning Ratios 1921–22 | | |

TABLE XIX. TWO-WAY FREQUENCY TABLES ILLUSTRATIVE OF THE RATES OF EARNINGS IN ONE YEAR AND THE PERCENTAGE CHANGES IN TOTAL ASSETS BETWEEN THAT YEAR AND THE SUCCEEDING YEAR

(*Public Utility Data*)

Earnings Ratios 1915	Percentage Change in Total Assets 1915–16										Total
	−3.9 to 0	0 to 3.9	4.0 to 7.9	8.0 to 11.9	12.0 to 15.9	16.0 to 19.9	20.0 to 23.9	24.0 to 27.9	28.0 to 31.9	32.0 to 25.9	
−3.9 to −2.0		1									1
−1.9 to 0.0											0
0 to 1.9		4	1	2							7
2.0 to 3.9	2	12	3	1	1	1		1			21
4.0 to 5.9	5	20	4	2	1		1			1	34
6.0 to 7.9		10	7	1		1					19
8.0 to 9.9		4	1		1						6
10.0 to 11.9							1				1
12.0 to 13.9		2									2
14.0 to 15.9			1								1
Total	7	53	17	6	3	2	2	1	0	1	92

| Earnings Ratios 1921 | Percentage Change in Total Assets 1921–22 | | | | | | | | | | |

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